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FOR THE BUSINESS OF MICROCOMPUTING

MAY 1981
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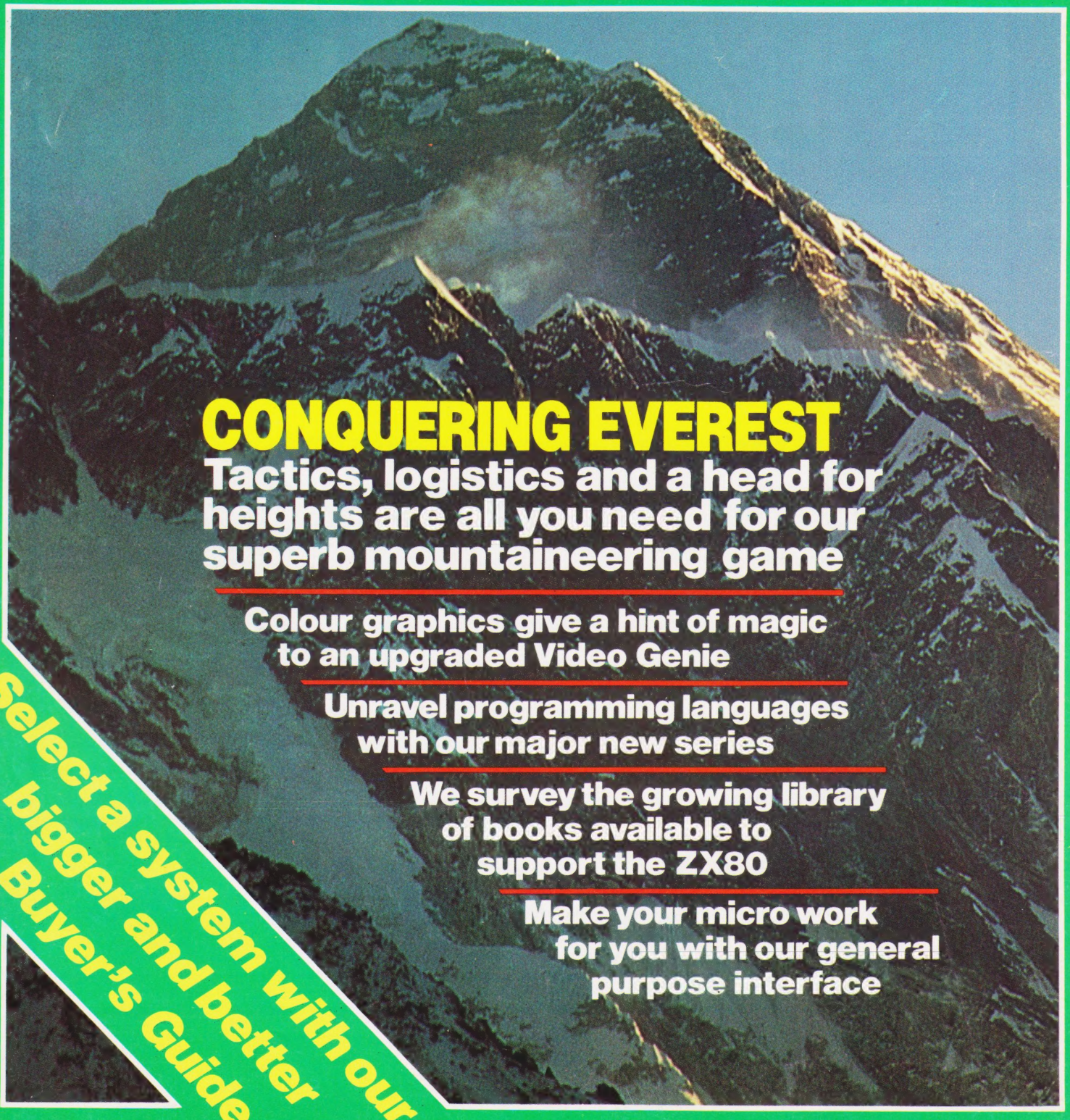

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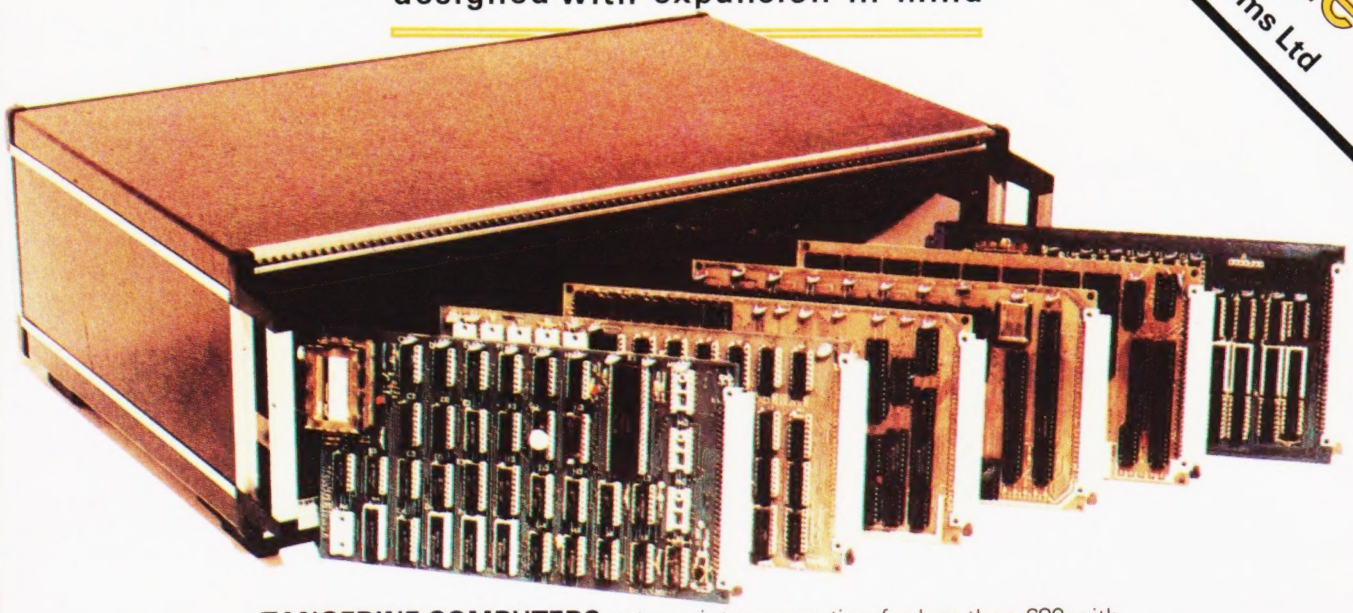

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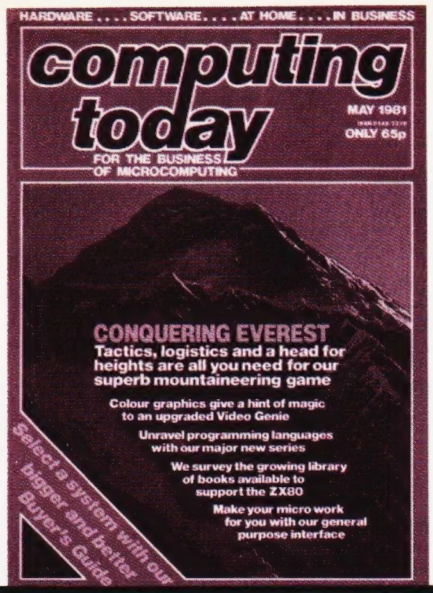

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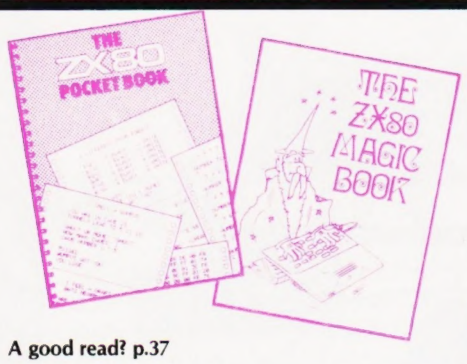

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A hint of Eastern promise p.55

Computing Today is constantly on the look-out for well written articles and programs. If you think that your efforts meet our standards please feel free to submit your work to us for consideration.

All material should be typed, but neat hand-written copy may be considered. Any programs submitted must be listed, cassette tapes and discs will not be accepted, and should be accompanied by sufficient documentation to enable their implementation. Please enclose an SAE if you want your manuscript returned, all submissions will be acknowledged. Any published work will be paid for.

All work for consideration should be sent to the Acting Editor at our Charing Cross Road address.

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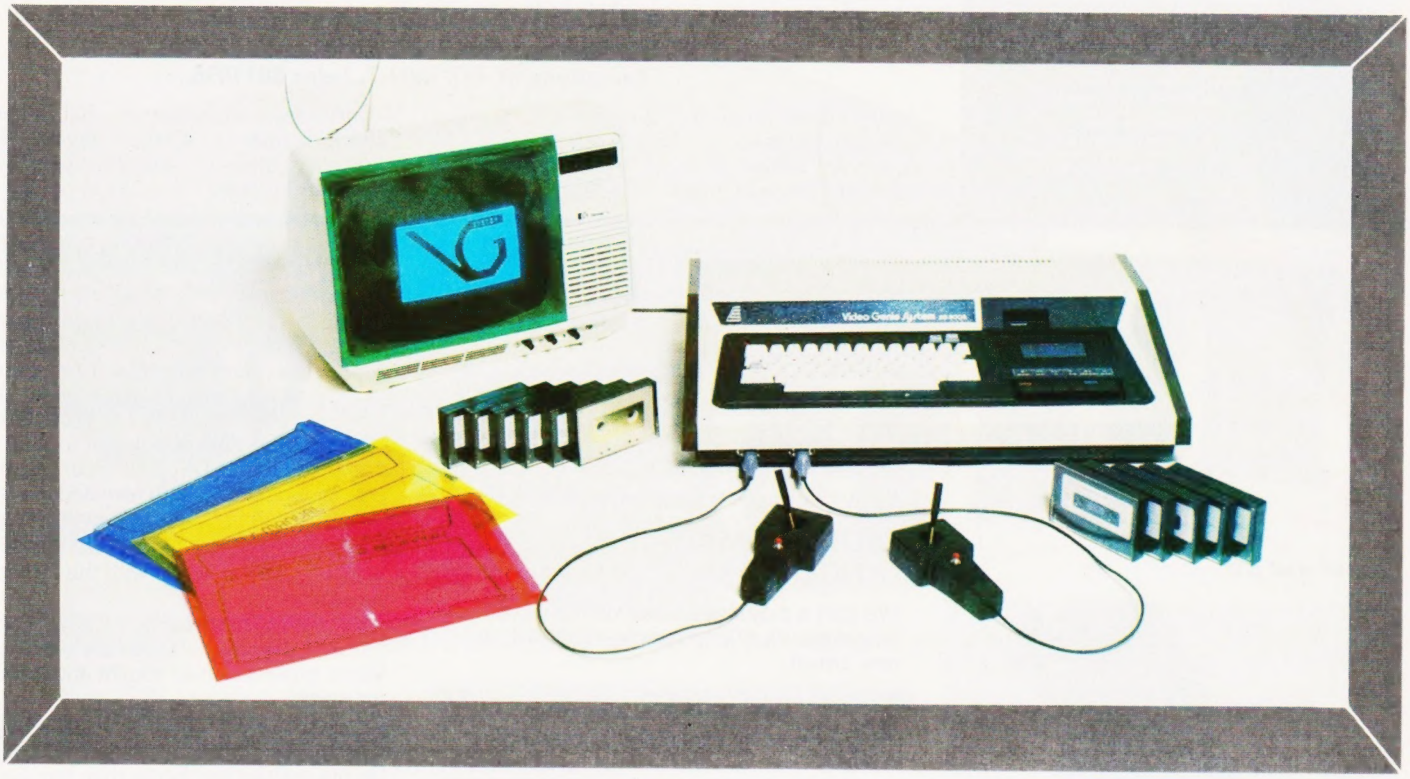

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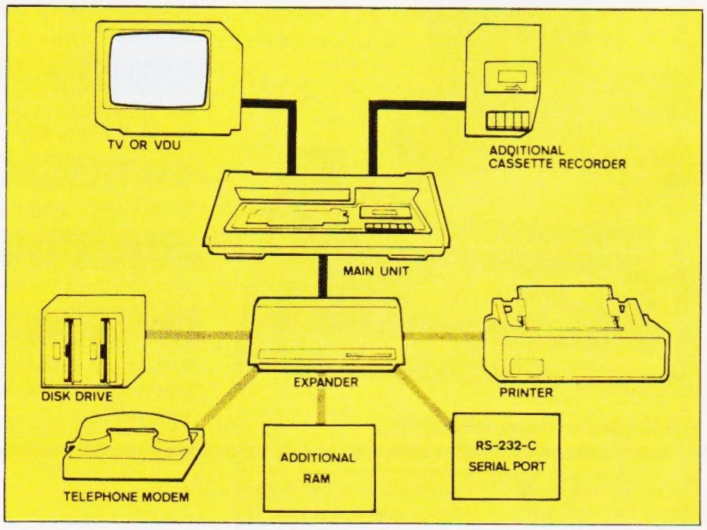

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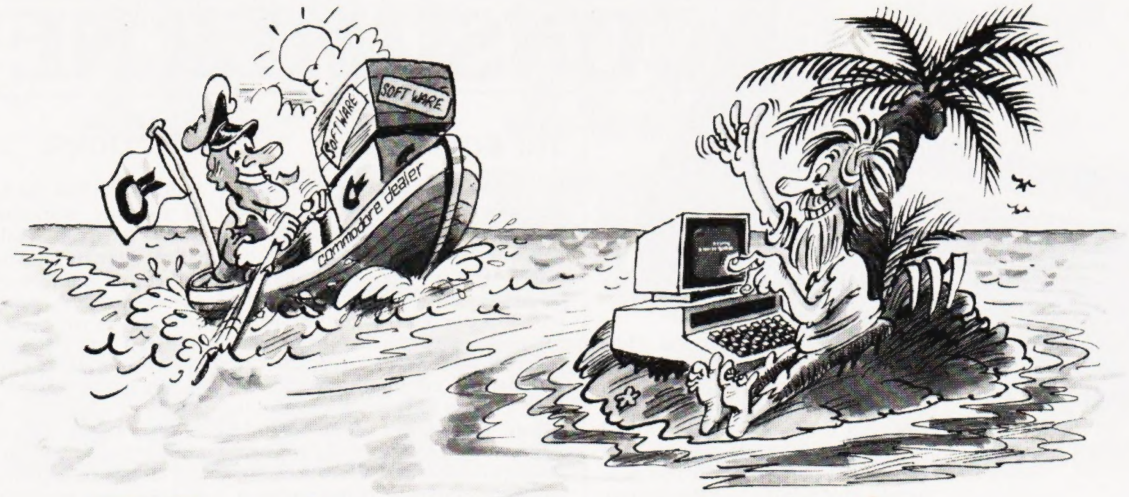

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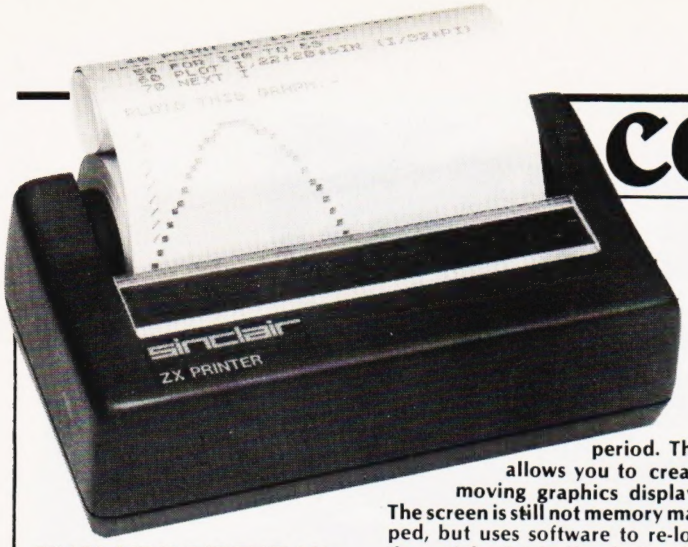
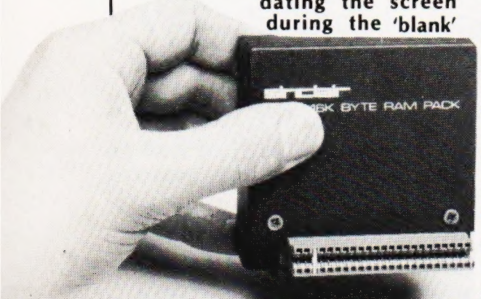


SINCLAIR'S BIRTHDAY BOY

Almost a year to the day from the start of production of the Sinclair ZX80 comes the sad news that, for the UK market at least, the product has been scrapped. However, as we revealed briefly last month it has been replaced by the ZX81. Using a Z80A processor with two RAM chips giving 1K of storage and custom made (and hopefully unrip-offable) ROM device from Ferranti, a ULA for the technically minded, it must be the smallest chip-count machine ever. The human interface is still the touch keyboard as featured on the '80 but each key can now perform up to five different functions. The new unit is housed in a much more durable ABS case and features the 8K BASIC that was originally destined for the '80 which contains many new functions. As well as the previously mentioned (back in our November issue) features the BASIC also offers control of the simultaneously announced printer. The most impressive improvement to the BASIC is the option of FAST or SLOW mode operation. This feature allows the processor to drop the screen handling functions and process the program as fast as it can or, in SLOW mode, give a flicker free display by updating the screen during the 'blank' period. This allows you to create moving graphics displays, The screen is still not memory mapped, but uses software to re-load the serial print buffer during that fraction of time when the screen is blank. The printer is a diminutive electrostatic device produced especially for Sinclair which can copy a screenful of information, dot by dot, in approximately 12 seconds, it can also act as a straight listing device. Both the printer and the new ROM can be retrofitted to the '80 although you won't get the flicker-free display. The existing 16K RAM pack will fit onto the '81. Sinclair also launched a range of cassette software, each tape costing £3.95 and holding up to seven programs; games, household management etc. Production of the new machine will take place at the Timex factory in Dundee at 10,000 a month, the level at which the '80 is currently being produced although some 50% of those are now going overseas to the USA. The Munich and Paris offices are also starting to do brisk business. Sinclair is seriously looking towards doing a deal with a major High Street chain, or at least that is the inference one must draw from seeing a man from W H Smith wandering about at the launch, but Clive Sinclair refused to comment. What he did comment on, however, was the decision by the BBC to use the Acorn based machine rather than his. Despite Sinclair's new production capacity and his apparent willingness to completely re-design the machine to meet the exacting BBC specifications it must be said, in all fairness to both sides, that the task would have been one of Herculean proportions and, given the July deadline and the existence of Acorn's PROTON, the final choice must have been the wisest one. What is equally obvious is that neither he nor any of the other companies who were considered is going to let such a vast market opportunity slip by unchallenged. The price of the '81 is £69.95 built and £49.95 in kit form with the printer coming in during June at £49.95.



THE BOYS IN BLUE

Ian Trackman of Blue Chip Software has taken the first step on the long road to sorting out illegal copying and selling of computer software. After finding an unauthorised source marketing their Super Editor he has referred the details to the police for further investigation. He also firmly stated that it will be the continuing policy of Blue Chip to take similar action if other cases are discovered. Plagiarism may be the sincerest form of flattery but in the growing software market it is becoming a problem of almost nightmare proportions. Whilst on the topic of program piracy there is an excellent book on the market called Legal Protection of Computer Programs by Bryan Niblett. It's published by Oyez Publishing Ltd of Norwich House, 11/13 Norwich Street, London EC4A 1AB and costs £10 for its 155 pages. The ISBN is 0 85120 509 7 if you have any trouble finding it.

AUTO UTILITIES

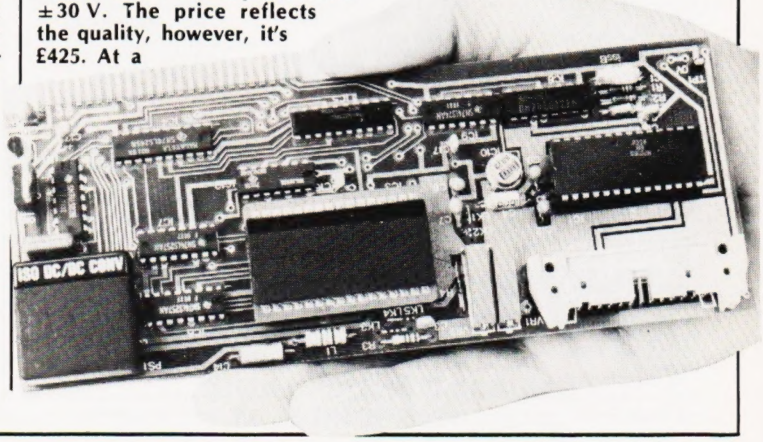
One of the more useful Commodore disc utilities, the Universal Wedge, has now been incorporated into an autostart ROM package by Machsize. Available for 3032 and 8032 series PETs it replaces one of the existing ROMs and adds a second containing a repeat key function and a proven RUN/STOP disable routine. Price is £38 and full details can be obtained from Machsize at York House, Clarendon Avenue, Leamington Spa CV32 5PP.

ON COURSE

Mills and Allen are holding a pair of two-day workshops on Computer Assisted Training at the Gloucester Hotel. These are being run in conjunction with the Manpower Services Commission and will take place on the 30th April/1st May and again on the 4th/5th of June. For full details contact Brigitte Burnett at Mills and Allen Communications, 1-4 Langley Court, Long Acre, London WC2E 9JY or ring on 01-240 1307. BIS Applied Systems are to hold a five-day, non-residential workshop on "Practical Project Management" for people who are likely to undertake the management of computer based projects. It will be held at the Kensington Close Hotel and runs from the 27th April at a cost of £425 plus VAT. Further information is available from Jackie Preuss at BIS Applied Systems, York House, 199 Westminster Bridge Road, London SE1 7UT or ring on 01-261 9237. A range of courses are being run by Agar Computer Services including an introductory course for recent purchasers of equipment, this is intended to relieve the load on retailers. A second course on BASIC programming is offered and runs every second weekend for two days over the weekend and costs £50 plus VAT. We've mentioned this one before but forgot to say that you can actually take your own machine along in order to discover its own quirks of programming. Details of both these courses and Agar's 'specials' can be obtained from Mr Agar-Hutton at 194 Kilburn High Road, London NW6 or ring on 01-328 9232.

UK APPLE I/O

Just a few days after the announcement that Apple are taking over their UK distributor, Microsense, news arrived of a range of British designed and produced interface cards for the machine. Flagship of the trio is a 16 channel ADC offering 12 bit resolution with a conversion time of 25 uS. Made for the professional market it provides link selectable input range selection to ±10 V and is protected to ±30 V. The price reflects the quality, however, it's £425. At a slightly more affordable level for the personal market comes a 16 channel digital input module with opto-isolation for £70 and a companion 16 channel output module for £140. All the units have ribbon cable header sockets for connection to the outside world and will plug into any Apple I/O slot. For a data sheet on the units contact MC Computers at Park Street, Newbury, Berkshire RG13 1EA or ring on 0635-44967.



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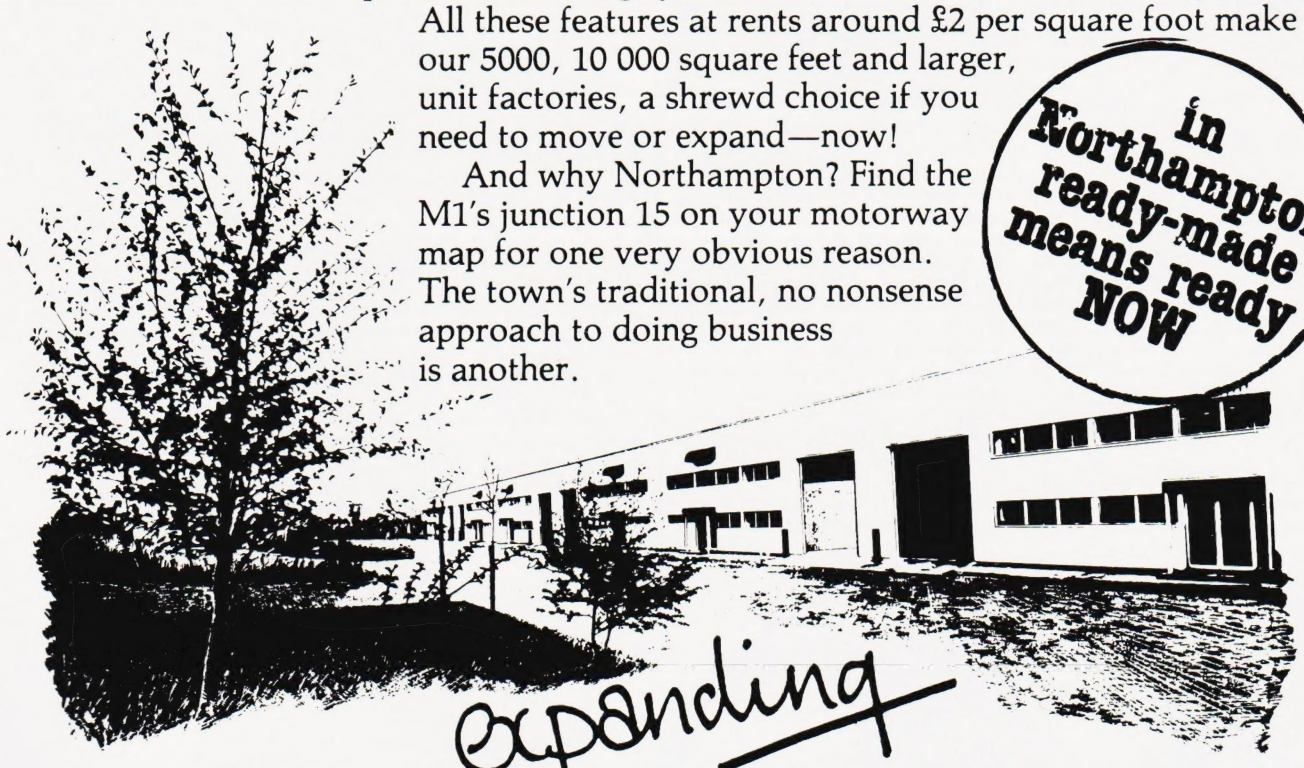

expanding

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CONSUMER NEWS

PROMS IN CONCERT

Blowing one's own memory devices seems to be a growing pastime judging by the increasing number of PROM programmers on the market. Thandar, the test equipment division of Sinclair Electronics, have announced the PKW-5000 intelligent programmer which is capable of blowing most popular types of EPROM. Using a Z80 to control features such as block verification and data input/modification it holds all the code in 16K of RAM prior to burning it in. An optional expansion interface allows interconnection with a terminal through an RS323 serial port or with a micro through a parallel port for downloading of software. Cost of the basic unit is £799 + VAT and technical information can be obtained from Thandar at London Road, St Ives, Huntingdon, Cambs PE17 4HJ. As a further example of this trend in putting software into EPROM is the Davidson-Richards unit for the PET. Capable of handling 2 or 4K devices it plugs onto the user and cassette ports at the rear of the micro. Operating software is supplied on disc but a limited version is available on tape. Data can be read from disc or RAM/ROM and the information can be processed before committal. The display of the code can be as a straight Hex dump or as a disassembled listing. For further details contact the company at 14 Duffield Road, Derby DE1 3BB.

MODEMS ON LINE

Two additions to the world of acoustic couplers this month. The first offering comes from Anderson Jacobson and is a 1200 baud full duplex mode unit, the first of its type to gain the necessary PO approval. Designated the AJ1234 it is a development of their existing range and includes a new type of acoustic 'cup' to positively lock the telephone handset into place. This both cuts down the possibility of external interference and reduces the chance of accidental disconnection. Full details are available from Anderson Jacobson at 752 Deal Avenue, Slough, Berkshire SL1 4SJ or ring them on Slough 25172. The second unit is a 300 baud device designed and manufactured in Sweden. Built into an extruded aluminium case it looks both neat and, from the test that I've put it through, certainly appears to perform well. Connection to your terminal, or micro, is via an RS232 serial port. The unit, together with its 'plugpack' power supply will set you back £195 plus £3 postage plus that inevitable 15%. Full technical information from Portable Microsystems, Forby House, 18 Market Place, Brackley, Northants NN13 5SF or ring on 0280-702017.

SELF TAUGHT APL

Using computers for training purposes is a growing area in the educational marketplace, systems such as the Control Data 'Plato' being often quoted examples, but there is a new, all British software package that looks set to carve out a niche for itself. Called Microspan it is an APL training programme which provides step-by-step tuition and testing on the user's progress. Produced by MicroAPL it is available on the Macroprocessor range of microcomputers which are S100/Z80 based systems capable of supporting 2Mb of discs running under CP/M. For details of both the training package and the computer contact MicroAPL at 19 Catherine Place, Victoria, London SW1E 6DX or ring on 01-834 2687.

BOOKS ON THE MOVE

John Wiley and Sons, publishers of technical books that we have reviewed from time to time, have just concluded an agreement to market material produced by Dr Graham Beech's Sigma Technical Press. This includes the current range of books including Dr Beech's "Successful Software for Small Computers" and Martin Banks's "Living With The Micro" and their range of software that goes with them. The distribution and marketing deal covers the UK, Europe and Africa. In future all orders for Sigma titles should be sent to John Wiley and Sons Ltd, Distribution Centre, Shripney Road, Bognor Regis, West Sussex rather than to Sigma.

HIGH TEX

Nice to see some information on an all-British product coming through the post, this particular parcel of data was from Tex Microsystems who are perhaps best known for their range of EPROM erasers. Among the new product for 1981 is a new version of their eraser which has been made more light-proof than the existing model and incorporates a cut-off switch for the UV tube when the door is opened. Cost of the new model is £45 and a separate timer unit is also available at £15. Tex also produce a series of VDUs based on their model VT64. This is a dumb (glass teletype) unit with a 12" screen supporting the full 96 character ASCII set displayed as 16 lines of 64 characters. The cursor is not directly addressable but they do provide a software solution. The unit is supplied without a keyboard but it has a parallel port provided, the normal system communication is handled by an RS232 serial port running between 50 and 19,200 baud. Price of the basic unit, many options are available, is £299 and the Tex keyboard is £99. For data sheets on these and other Tex products contact them at 126 New House Park, St Albans, Herts AL1 1UP or ring on St Albans 564077.

Accounting
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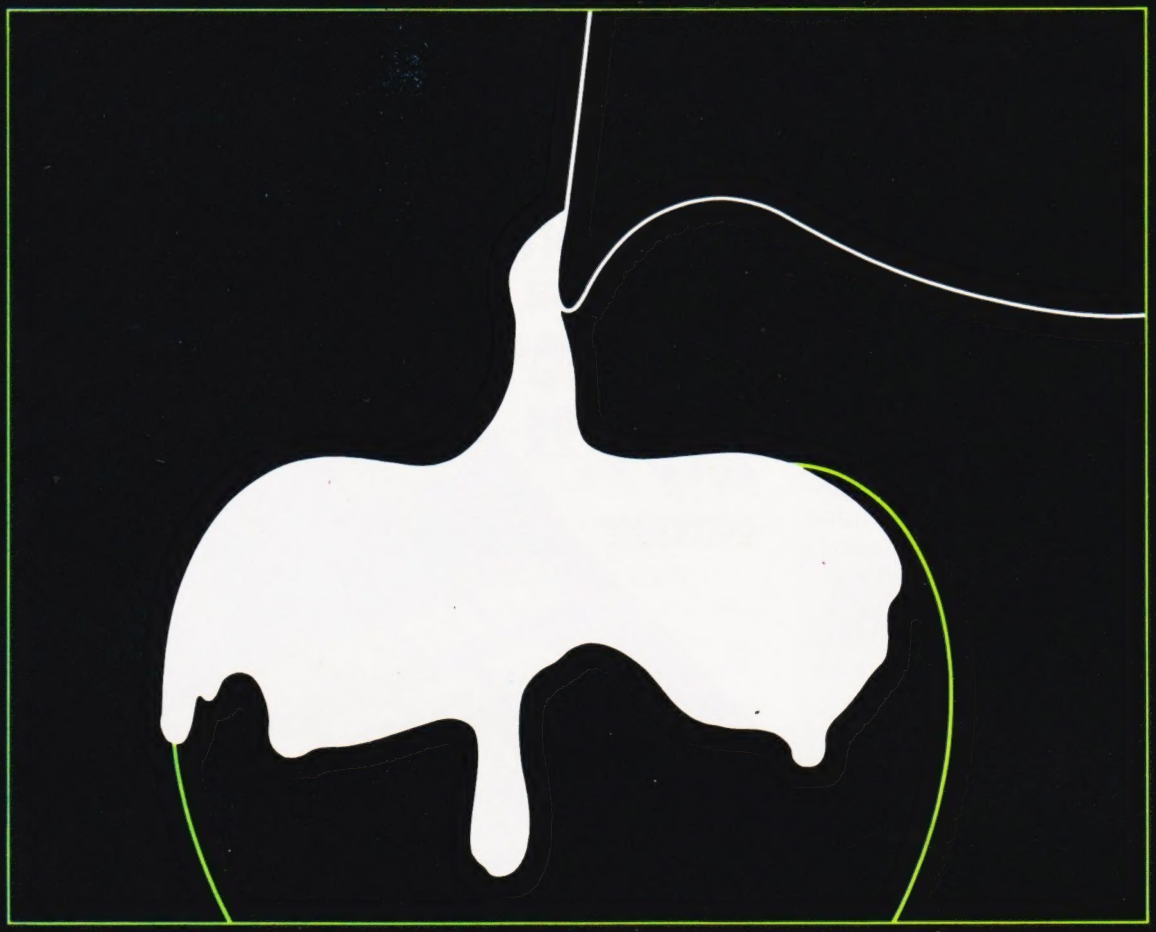
TABS



The cream for your apple.

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To ensure that our low cost accounting system* is fully understood, TABS offer a full support service, through our national dealer network, that includes training courses, consultancy and free seminars.

Modules include: Purchase Ledger, Sales Ledger, Nominal Ledger, Payroll, Stock Control, Job Costing, Word Processing, Training, Support, Management Accounts, Invoice Compiler, Fast Data Entry, Sales Order Processing, Mail List.

Each module costs an astonishingly low **£99**

*The minimum system required to run the TABS modules is:
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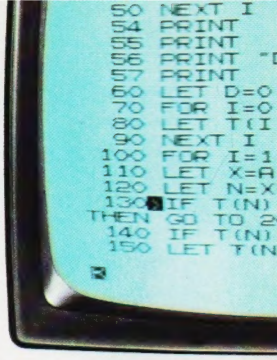
Accounting Business Systems TABS

New! Sinclair ZX81 Personal Computer.



Kit: £49.95 complete

Built: £69.95 complete

Reach advanced computer comprehension in a few absorbing hours

1980 saw a genuine breakthrough – the Sinclair ZX80, world's first complete personal computer for under £100. At £99.95, the ZX80 offered a specification unchallenged at the price.

Over 50,000 were sold, and the ZX80 won virtually universal praise from computer professionals.

Now the Sinclair lead is increased: for just £69.95, the new Sinclair ZX81 offers even more advanced computer facilities at an even lower price. And the ZX81 kit means an even bigger saving. At £49.95 it costs almost 40% less than the ZX80 kit!

Lower price: higher capability
With the ZX81, it's just as simple to teach yourself computing, but the ZX81 packs even greater working capability than the ZX80.

It uses the same micro-processor, but incorporates a new, more powerful 8K BASIC ROM – the 'trained intelligence' of the computer. This chip works in decimals, handles logs and trig, allows you to plot graphs, and builds up animated displays.

And the ZX81 incorporates other operation refinements – the facility to load and save named programs on cassette, for example, or to select a program off a cassette through the keyboard.

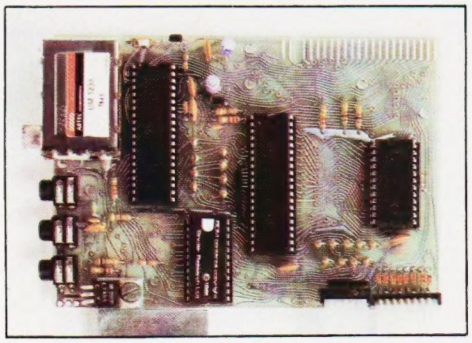
Higher specification, lower price – how's it done?
Quite simply, by design. The ZX80 reduced the chips in a working computer from 40 or so, to 21. The ZX81 reduces the 21 to 4!

The secret lies in a totally new master chip. Designed by Sinclair and custom-built in Britain, this unique chip replaces 18 chips from the ZX80!

Kit or built – it's up to you!

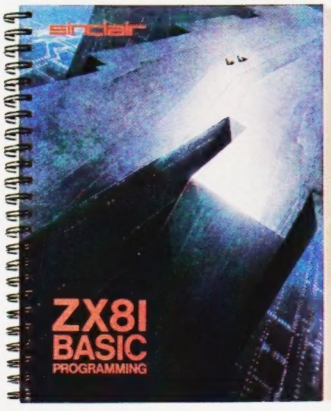
The picture shows dramatically how easy the ZX81 kit is to build: just four chips to assemble (plus, of course the other discrete components) – a few hours' work with a fine-tipped soldering iron. And you may already have a suitable mains adaptor – 600 mA at 9 V DC nominal unregulated (supplied with built version).

Kit and built versions come complete with all leads to connect to your TV (colour or black and white) and cassette recorder.



Proven micro-processor, new 8K BASIC ROM, RAM – and unique new master chip.

New BASIC manual



Every ZX81 comes with a comprehensive, specially-written manual – a complete course in BASIC programming, from first principles to complex programs.

If you own a Sinclair ZX80...

The new 8K BASIC ROM used in the Sinclair ZX81 is available to ZX80 owners as a drop-in replacement chip. (Complete with new keyboard template and operating manual.)

With the exception of animated graphics, all the advanced features of the ZX81 are now available on your ZX80 – including the ability to drive the Sinclair ZX Printer.

Coming soon- the ZX Printer.

Designed exclusively for use with the ZX81 (and ZX80 with 8K BASIC ROM), the printer offers full alpha-numerics across 32 columns, *and* highly sophisticated graphics. Special features include COPY, which prints out exactly what is on the whole TV screen without the need for further instructions. The ZX Printer will be available in Summer 1981, at around £50 – watch this space!

16K-BYTE RAM pack for massive add-on memory.

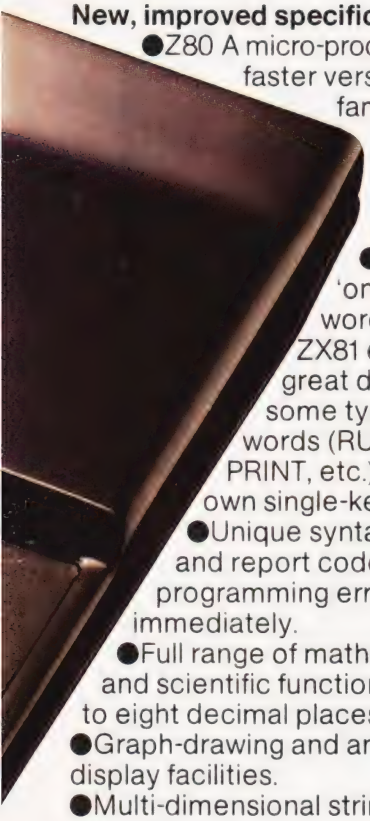
Designed as a complete module to fit your Sinclair ZX80 or ZX81, the RAM pack simply plugs into the existing expansion port at the rear of the computer to multiply your data/program storage by 16!

Use it for long and complex programs or as a personal database. Yet it costs as little as half the price of competitive additional memory.

How to order your ZX81

BY PHONE – Access or Barclaycard holders can call 01-200 0200 for personal attention 24 hours a day, every day. BY FREEPOST – use the no-stamp-needed coupon below. You can pay by cheque, postal order, Access or Barclaycard. EITHER WAY – please allow up to 28 days for delivery. And there's a 14-day money-back option, of course. We want you to be satisfied beyond doubt – and we have no doubt that you will be.

New, improved specification



- ●Z80 A micro-processor – new faster version of the famous Z80 chip, widely recognised as the best ever made.
- ●Unique 'one-touch' key word entry: the ZX81 eliminates a great deal of tire-some typing. Key words (RUN, LIST, PRINT, etc.) have their own single-key entry.
- ●Unique syntax-check and report codes identify programming errors immediately.
- ●Full range of mathematical and scientific functions accurate to eight decimal places.
- ●Graph-drawing and animated-display facilities.
- ●Multi-dimensional string and numerical arrays.
- ●Up to 26 FOR/NEXT loops.
- ●Randomise function – useful for games as well as serious applications.
- ●Cassette LOAD and SAVE with named programs.
- ●1K-byte RAM expandable to 16K bytes with Sinclair RAM pack.
- ●Able to drive the new Sinclair printer (not available yet – but coming soon!)
- ●Advanced 4-chip design: micro-processor, ROM, RAM, plus master chip – unique, custom-built chip replacing 18 ZX80 chips.

To: Sinclair Research Ltd, FREEPOST 7, Cambridge, CB2 1YY. **Order**

Qty	Item	Code	Item price £	Total £
	Sinclair ZX81 Personal Computer kit(s). Price includes ZX81 BASIC manual, excludes mains adaptor	12	49.95	
	Ready-assembled Sinclair ZX81 Personal Computer(s). Price includes ZX81 BASIC manual and mains adaptor.	11	69.95	
	Mains Adaptor(s) (600 mA at 9 V DC nominal unregulated).	10	8.95	
	16K-BYTE RAM pack(s).	18	49.95	
	8K BASIC ROM to fit ZX80.	17	19.95	
	Post and Packing.			2.95

Please tick if you require a VAT receipt ☐ **TOTAL £** _____

*I enclose a cheque/postal order payable to Sinclair Research Ltd, for £ _____

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sinclair ZX81

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Microdigital are the hardware experts – here's why you should buy your Genie from us ★ Low Price of £280 + VAT ★ Each computer tested by our engineers before despatch ★ 12 month parts and labour guarantee ★ Free delivery within mainland U.K. ★ Bona fide official orders welcome ★ Latest version of Genie

The Video Genie is a complete computer system, requiring only connection to a domestic 625 line TV set to be fully operational, or if required a video monitor can be connected to provide the best quality display

The system case contains the Central Processor Unit (CPU), 16,000 bytes RAM memory, the cassette system, a 12,000 byte operating system and BASIC interpreter in ROM, and a full size keyboard, in a stylish case, at a price that makes the Video Genie better value than some "kit" computers

Applications

The Video Genie System has many uses in all spheres of life, the easy to use BASIC language means that programs are easily written for specific applications, and pre-recorded program tapes are available in great variety

The system has great scope in the home, sophisticated games programs can introduce the computer age to all the family, who can then progress to writing their own programs in BASIC or even machine code. Software is continuously being developed to aid home budgeting and education

In a school or college the machine can be used with a large screen TV to allow a whole class to be taught at once

The powerful Extended BASIC interpreter makes the solution of complex scientific problems simple and the graphics allow pictorial displays of results

Prices	Nett	Vat	Total
Video Genie Computer	280 00	42 00	322 00
EG3013 Expander with RS232	215 00	32 25	247 25
EG3013 Expander without RS232	185 00	27 75	212 75
32K Memory Board S100	130 00	19 50	149 50
16K Memory Board S100	95 00	14 25	109 25
Dual Disk Drive (40 track)	410 00	61 50	471 50
2 Drive Cable	17 00	2 55	19 55
4 Drive Cable	32 00	4 80	36 80
Printer Cable	17 00	2 55	19 55
Centronics Parallel Interface for unexpanded Genie	33 00	4 95	37 95
Sound kit	10 00	1 50	11 50
fitting above	5 00	75	5 75
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BUSINESS NEWS

MAKING MICROS PAY

The new small business system from Triumph Adler, the Alphatronic, is rapidly acquiring software to run. Compuserve have just announced a payroll package called FLEXIPAY which is capable of handling monthly, weekly and hourly paid staff. One interesting feature is that all the computed payment figures are displayed for checking prior to printing out the payslips. The program can also print out forms on which the required data can be entered before keying it in to the system. A total of 18 separate reporting functions are available from P45 enquiry to analysis by individual or by department. The software is fully guaranteed for one year which includes all ammendments made necessary by changes in the tax laws or National Insurance regulations. This guarantee, effectively a software maintainance agreement, can be extended after the first year for a modest sum. For further information contact Compuserve at 13/14 Charterhouse Square, London EC1 or ring on 01-253 7256.

CARTING IT ABOUT

Busy DP departments with mounds of printout to shift around and store will be relieved to hear of a new, mobile 'Data Cart' from Eldon Office Products. The seven trays can hold up to 4000 sheets of continuous paper and this capacity can be expanded by clipping extra trays on top. The unit is desk high making it a convenient replacement for piles of files cluttering up the desk. A full colour catalogue featuring the entire Eldon range is available from them at Unit 3, Shefford, Bedfordshire SG17 5AB.

VISICALC LINKS UP

As we mentioned last month on these pages Compsoft have linked Wordpro and Wordcraft into their Data Management System. Well, they've done it again with VisiCalc. Information stored in the DMS files can be directly transferred to the VisiCalc DIF files for statistical analysis. DMS can even preprocess the information making it possible to look at items in more detail. An update package is available to existing users of DMS or you can buy it with the link built in for £200. Contact Compsoft at Great Tangley Manor Farm, Wonersh, Nr Guildford, Surrey or ring Heather Kearsley on Guildford 39665.

MEMOS TO WRITE

Almarc, the people who distribute Vector Graphic computers in the UK, have released a new wordprocessing package called MEMORITE III. I often wonder what I and II were like in cases such as this! Based on the CP/M operating system it is claimed that it will turn any Vector machine into a top-line wordprocessing system that can be added onto to suit the individual's needs. This also means that the user can help Vector produce a better version next time around. Further information can be obtained from David Swain at Almarc Data Systems, 906 Woodborough Road, Nottingham NG3 5QS or ring on 0602-625035.

MATRIX NOISE KILLER

Latest in the Hush-Top range from Power Equipment is a silencer for the popular Centronics 737 matrix printer. Claimed to muffle 80% of the noise that the matrix head makes as it screeches across the page producing its high quality print it is simple to fit. Consisting of a heavy gauge steel tray covered in acoustic foam on which the printer sits and an acrylic top whose sides are lined with the same material, it does not effect any of the paper handling mechanisms. The clear hinged top allows the operator to check what's going on and the whole thing only takes around five minutes to fix. Because acoustic foam is also a good heat insulator the case is fitted with a small fan as standard. Descriptive literature is available from The Power Equipment Co Ltd at Kingsbury Works, Kingsbury Road, London NW9 8UU.

MEMORY UPDATE

If you've got about £5000 to spend on a small business micro, the upgraded version of the Memory System 7000 may be worth a look. Comprising a Z80 processor, 64K of RAM, half a megabyte of floppy disc store running under CP/M, a 12" VDU and a printer the system can be configured for wordprocessing as well as business use. The machine is now improved, both in the hardware (a faster disc controller) and the software and actually costs less than it did when first launched. Other improvements include the capability to create your own character sets and an in-built clock/calendar unit. The disc storage capacity can be expanded by adding an optional 8" floppy giving either 2 or 4Mb. BASIC is supplied as standard with Pascal, MicroCOBOL and FORTRAN also available. Software packages can be supplied at between £300 and £400 if required. For more information contact Memory Computers (UK) Ltd at Britannia House, 960 High Road, N Finchley, London N12 9RY or ring on 01-445 6614.

FD1691 £15
FD1771 £25
FD1791 £36
WD2143 £5.50
Zero insertion force socket 24 pin £7
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4 way 90p
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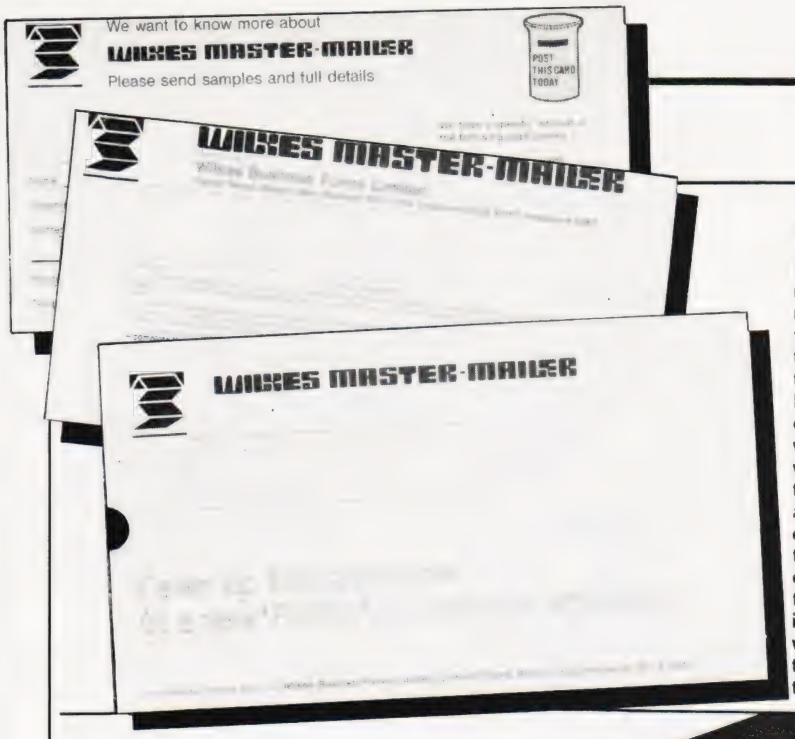
BUSINESS NEWS



PREPACKED MAILING

If your company does a lot of mailing of standard documents; promotional material, invoices etc, you will have probably found that the main bottleneck in the operation is the postroom. Wilkes Businss Forms claims to have solved this problem in a rather clever way. Basically they supply you with a sealed envelope containing the required forms or documents and a master copy attached to the outside. These multipart forms are then fed into a printer, or you could even use an office typewriter, and the master is filled in. By now you may be wondering what happens to the bits inside that sealed envelope. Well, that's the clever bit. By using carbonless copying compound in the envelope and other documents inside it the information on the master is transferred onto the correct sheets inside. The master can be stripped off the web and the envelope, ready addressed and pre-paid if required, is simply bunged in the post, neat eh? Because all the forms can be preprinted you can send confidential information without running the risk that Mr Jones will get Mr Smith's pay slip becuase of an error in the mailing room. Wilkes offer design assistance in the production of the product, called Master Mailer, and you can even have colour printing. For more information and samples contact Wilkes Master Mailer at Oxford Street, Bilston, W Midlands WV14 7DW

AYR GOES ON-LINE

After an injection of a massive £1M by eight City institutions Ayr Viewdata are going into production with their remote controlled Prestel adaptor unit. Post Office (British Telecom) approval was gained in January, several months after Tangerine got their TANTEL unit through, and the first deliveries are expected during April. Ayr's top man, "Tommy" Thomas, is hoping to get the bulk of the units into high street television and rental shops where the market for a low-cost adaptor unit is running high. Full production will be achieved later in the year when an automated plant comes into operation. A further model, also remote controlled, which has added Teletext capability is scheduled for the latter part of the year. For more details contact Ayr Viewdata at 77A Victoria Road, Surbiton, Surrey KT6 4NA.

REFORMAT IT

If your company uses IBM or DEC equipment and you want to access the software for use on your micro then a new package called REFORMATTER may have the answer. Two programs are available, one to transfer betwwen CP/M format and IBM 3740 format and a second to operate between CP/M and DEC single density floppies. A special version is also available to work on TRS 80 Model II's running under TRSDOS, it only transfers to the IBM format. Hardware requirements are a multiple drive system which includes at least one 8" soft sectored floppy. The package has been developed by MicroTech Exports of 467 Hamilton Avenue, Suite 2, Palo Alto, California 94301 who will be pleased to deal with your enquiries, Oscar A Rosenbloom is the man to contact. Please mention where you saw the news item as it helps both of us.

CHATTERING AWAY

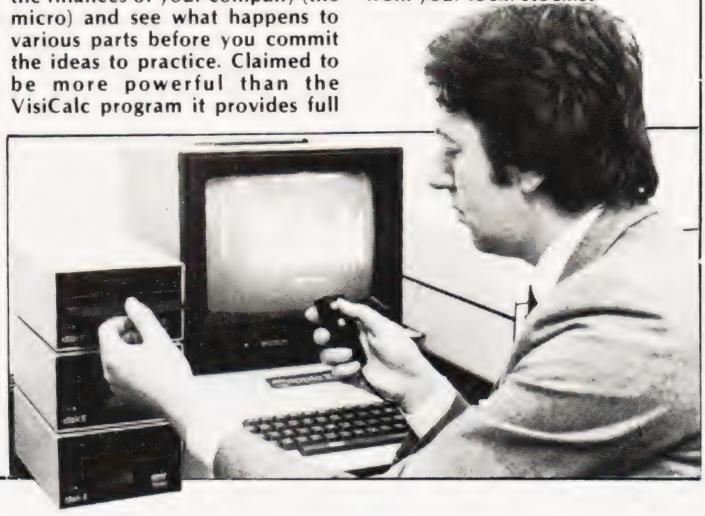
Just after we published the news item on the IBM Selectric interface in last month's issue (Select a Selectric) FormScan sent us details of their Chatterbox unit. Consisting of two floppy disc based interfaces one unit gathers information from typewriters such as the Selectric and the second is connected to the RS232 port on your wordprocessor. Any number of the first unit can be used with one of the second. All controls have been kept to a minimum and an LED display shows the last character typed allowing a keyboard operator to correct mistakes before they are entered. Full literature is available from FormScan at Apex House, West End, Frome, Somerset BA11 3AS or ring on 0373-61446.

TANTEL GOES RENTAL

The old saying about not being able to keep a good product down certainly appears to apply to TANTEL, the £170 Prestel adaptor produced by Tangerine. Back in the news once again they have just concluded an agreement with Granada, the TV rental people, who will now offer the units through their shops for £98 per annum. The product is shipping in large quantities both in the UK and abroad and we currently have one under test and hope to publish the results soon. This High Street rental agreement opens up a whole new area of business, perhaps we'll start to see personal computers for rent in the shops soon — video games are already well established and the technology is much the same. Tangerine were also approached by the BBC in conjunction with the forthcoming series on micros but their committment to the existing MICRON and the Prestel unit did not allow them to meet the rigid deadlines imposed. However, there are strong indications that a new product may be in the pipeline for the latter quarter of the year — watch this space!

MODELLING ON A MICRO

The runaway success of VisiCalc as a management tool has spawned a host of competitive products, the latest being Intelligence (UK) Ltd's Micromodeller. Distributed by ACT Microsoft it offers financial modelling facilities on a micro, the Apple, for around £2000 — the actual program costs £425 including documentation. The program allows you to try out new ideas on the finances of your company (the micro) and see what happens to various parts before you commit the ideas to practice. Claimed to be more powerful than the VisiCalc program it provides full colour graphical output and generates summary reports on command, it also offers some real-time financial functions too. One, rather gimmicky in my opinion, feature is the provision of a hand-held controller that allows you to store a series of charts and reports and then flick through them — a case of micro-showmanship perhaps? A brochure describing the product is available from ACT Microsoft at 5/6 Vicarage Road, Edgbaston, Birmingham B15 3ES or from your local stockist.



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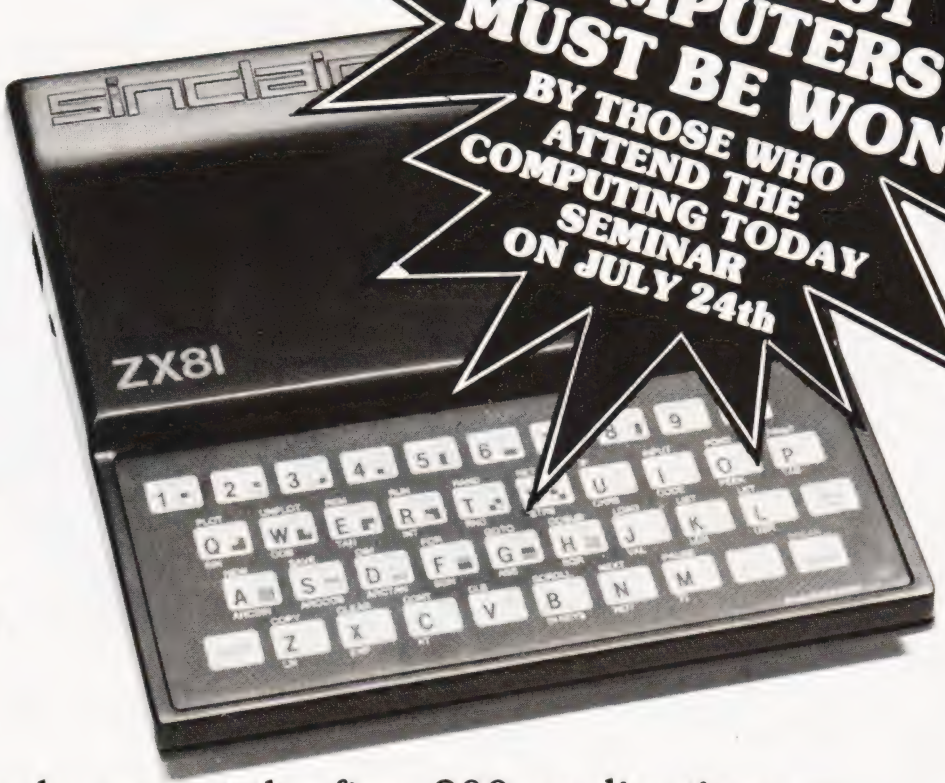

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9.30	Seminar Registration
10.00 - 11.00	Lecture I*
11.00 - 11.30	Break for Coffee
11.30 - 12.30	Lecture II*
12.30 - 14.00	Lunch
14.00 - 15.00	Lecture III*
15.00 - 15.30	Break for Tea
15.30 - 16.30	Question and answer forum
17.00	Seminar closes

* The order of lectures will be confirmed later.

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16K RAM, expandable to 48K
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Expander Box	£195.00
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9″ B/W high quality monitor	£85.00
9″ Green phosphor monitor	£95.00
Single disk drive	£225.00
Dual disk drive	£440.00
Technical Manual	£5.00
Programming Guide	£5.00

All prices exclude VAT (if applicable).

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FLEXIBLE STORAGE

Although floppy discs symbolize the top end of the personal computer storage stakes, they still represent a huge capital outlay for most users. What many people really need is a system which can handle data considerably faster and more convenient than a cassette but doesn't cost the proverbial arm and a leg. The "Stringy Floppy", in this case Aculab's Floppy Tape, seems to be a fast, convenient alternative to the traditional cassette and has been much acclaimed in the States. Our reviewer has had one under test for several months and describes its strengths and weaknesses. If you are considering an alternative mass storage unit to the floppy disc then this review is essential reading.

BUBBLING UNDER

The great white hope of the semiconductor memory market is the "bubble". Much has been said concerning its low cost and its high speed compared to mass storage devices but little has been explained about its internal workings. In a major feature we take the lid off these intriguing devices and explain all about domains, major and minor loops and the rest of the weird and wonderful technology that makes them tick. It may not reduce their currently awesome price but at least you'll be able to dazzle your friends with your knowledge — unless they've read it too!

FORTRAN, THE ORIGINAL LANGUAGE

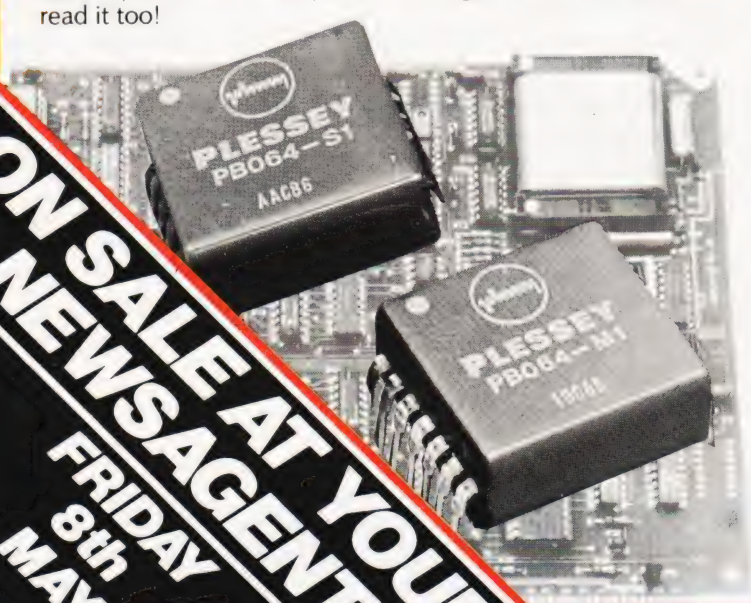
Continuing our series on programming languages Dr Marshall takes a look at the original high level language. FORTRAN. Originally designed for scientific and engineering users it is still going strong and micro based versions abound. Indeed, many more modern languages use some of its facilities, BASIC is a prime example. Take a step back in history with next month's issue.

ANALOGUE STRIKES AGAIN

One of the most useful and popular interface units for computers is an Analogue to Digital converter. Based on the ZN425 device this unit fits neatly onto a standard Eurocard and has been designed by the makers of the chip, Ferranti. It will connect directly to a 6522 VIA device so it is suitable for use with any 6502 based micro, simple changes will allow its operation on PIA/PIO based machines. If you are looking to connect your micro to the real world then this one's for you.

MICRO MANIPULATIONS

You may remember the TI Programmer that we reviewed some months ago. Well, next month we present a full simulation of this machine on a Z80 based micro, the TRS 80. As well as being a useful program in its own right it also offers a whole host of versatile subroutines for use in other programs. Get the best of both worlds, an excellent program and a number of valuable subroutines — two for the price of one in next month's issue.



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PROGRAMMING LANGUAGES

Dr G J Marshall

Dr G J Marshall, Principal Lecturer in Electronics at the Polytechnic of North London, starts the series off with a look at COMAL

The arguments between the supporters of BASIC and Pascal are currently raging in the pages of Computing Today and elsewhere. This argument is only one in a series of such disagreements, for instance, three or four years ago feelings were getting very heated between the devotees of ALGOL 68 and Pascal. While such comparisons and discussions are clearly healthy, they seem doomed to be unresolved.

I tend towards the view that *any* language is a good one as long as it lets you do what you want to. The fact that someone else can achieve a solution to your problem that is in some way superior to yours by using another language doesn't necessarily help you much. It is undoubtedly true that in certain applications some languages are better than others, but that a particular language is superior to others over a large range of applications seems to me very doubtful.

Natural Language

The purpose of any computer language is to provide a medium for describing solution methods, or procedures for achieving some objective, in a *precise* way. The difficulties in communicating with a computer in a natural language, such as English or French, stem largely from their inherent ambiguity and lack of precision. Of course, natural languages permit the expression of a tremendous variety of shades of meaning that simply cannot be attempted using a computer language. In an interesting analogy, it can be asserted that, for a specific purpose, some natural languages are 'better' than others. For example, Spanish is supposed to be the easiest of the European languages to learn because its pronunciation is natural and its grammatical rules are fairly rigid. Again, French is accepted as the international language of diplomacy, so that, in this sense, it is accepted as the best. Perhaps this is because of the precision of expression that can be achieved in the language, although the characteristic obstinacy of the French may have something to do with it, too. If arguments persist over the relative merits of natural languages, it isn't surprising that computer languages attract the same controversy.

The ambiguity of natural language is well illustrated by sentences such as:

Flying planes can be dangerous.
I don't like eating apples.
Time flies.

Whether the last example should be taken as an instruction to time insects or as a comment on how quickly time passes is not clear without more information being provided. A computer cannot understand and respond to an ambiguous communication if its meaning is not clear. It may be able to take one meaning of the communication, but there can be no guarantee that it is the intended one. People resolve the ambiguity of a communication in natural language by relating it to its context. Computers can be programmed to do the same, but the representation of information and the inclusion of all the knowledge that is likely to be required to provide a context for the received communication is a complex problem from the artificial intelligence area.

Another problem in understanding natural language stems from the richness of the grammatical rules for constructing correct sentences. This richness leads to sentences like the following pair:

Time flies like an arrow.
Fruit flies like a banana.

Both sentences are meaningful. Their deceptive similarity conceals different grammatical constructions. Determining the structure of a sentence (its syntax) is a necessary preliminary to finding its meaning, but being sure of the structure can be difficult. Besides this, in a natural language it is possible to invent properly structured sentences that are entirely meaningless, such as Chomsky's

Colourless green ideas dream furiously.

Computer languages have been designed as artificial languages with comparatively simple grammatical rules to avoid all these problems. Thus, when a programmer communicates with a computer in a programming language, he can be sure of how the computer will respond in executing the instructions. There will be no ambiguity. The structure and meaning of each instruction will be surely discovered. There will be no 'nonsense' instructions. Every legally constructed instruction will have a precise interpretation, which is hopefully the one intended by the programmer.

Man Versus The Machine

Any processor only understands its *own* machine code, so that programs written in a high-level language must be translated to machine code before they are executed. The translator is known as an interpreter if translation and execution proceed one line at a time, and as a compiler if the entire program is translated prior to execution. Thus, interpreters are suitable for program development, since they proceed as far as the first faulty instruction, while compilers will run fully developed programs as quickly as possible.

It is doubtful if the most sophisticated hardware/software combination in existence can, in a general way, out-perform the human brain. Current computer languages (and hardware techniques) make it difficult to achieve comparable sophistication. However, developments such as concurrent processing and predicate logic ensure that the stage at which the machines can be superior is approaching.

So, while the ensuing series of articles on computer languages won't resolve the arguments of the BASIC versus Pascal kind, it will provide a basis of information upon which the arguments can draw. Incidentally, in the COMAL language an interesting BASIC — Pascal compromise has been achieved. In the series, we will try to provide an appreciation of a wide variety of languages. A large number of languages have been available on mainframe computers for many years, and a comparable number is now becoming available on micros. In addition to the widely available BASIC and Pascal, LISP is available, for example on PETs and Apples, and as CP/M becomes more widely used a whole range of languages, including ALGOL, COBOL, FORTRAN and C enters the scene. As implementations improve, languages like ALGOL 68 may become available.

For the languages mentioned

above, and some others, we shall try to give some indication of why they exist, what they are like to use, and what applications they are intended for. We will try to give the flavour of each language by describing its main features and displaying a few programs that show the language to advantage.

Further Reading

If you are not familiar with a computer language, this series might help you to decide which is the one that you should learn. If you do know a language, it might persuade you that other languages have some merits and that they may be worth further investigation.

A deeper treatment of some of the ideas presented in this introduction can be found in 'The Thinking Computer' by Bertram Raphael (W H Freeman) and 'Chomsky' by John Lyons (Fontana/ Collins). The latter provides a guide to Chomsky's work, including that on language structures.

COMAL

— A New Recruit

It is not possible to give such clear cut and simple reasons for the existence of most of the languages covered in this series as it is for COMAL (COMmon Algorithmic Language). COMAL exists because of the dissatisfaction of Borge Christensen with Microsoft BASIC and the whole family of similar BASICs.

Borge Christensen is a Danish educationalist. His experience of using BASIC on microcomputers to teach computing in schools convinced him of the general unsuitability of BASIC for teaching good programming practice. He was keen to keep the simplicity of BASIC, which makes it easy to learn, but felt the need for extra facilities with which well structured programs could be written. He developed his language by observing the difficulties and the needs of his students, and then introducing features that he thought would help them overcome their problems and thus fulfil their needs. He found that the point of his innovations was readily perceived by the students, and the new features were rapidly accepted. In the event, the new features reflect rather closely the algorithmic structures of Pascal, so that COMAL has come to contain the best features of both BASIC and Pascal. This hybrid will benefit not only students learning a language for the first time, but also teachers anxious to promote good programming practice and any programmer wanting to produce well structured programs. One of the major points here is that any sizeable program can be understood, modified and maintained far more easily if it has good structure than if it is a "spaghetti" program. Christensen estimates that programs using COMAL to advantage can be developed three times faster, and maintained ten times more easily than the corresponding BASIC programs.

In the educational environment the particular advantage of COMAL, as a hybrid of BASIC and Pascal, is that it is as easy to learn as BASIC, so that the student learning his first language can learn it rapidly and write his first program quickly. It also provides a bridge to Pascal which is the major lanuage used in most University and Polytechnic computing degree courses. It can be extremely discouraging for students to have to learn a variety of dissimilar computing languages throughout their student career.

The Features Of COMAL

The aim of this section is to provide a flavour of COMAL and to indicate what it is like to use. There is no attempt to give a complete description!

Variable names can be up to 16 characters long, starting with a letter. The assignment symbol is the same as in Pascal, so that typical simple assignments are:

```
RECORDNUMBER := 17
POSITION$ := "LECTURER"
```

Such assignments can be used to make programs readable. The assignment symbol removes the apparent ambiguity of BASIC statements such as:

```
IF C = 10 THEN C = 0.9*C
```

This could be written in COMAL as

```
IF COST = 10 THEN COST := 0.9*COST
```

making it clear that the instruction contains a test for equality and an assignment.

The constants TRUE and FALSE are predefined in COMAL (they are equivalent to 1 and 0, respectively), and they permit suggestive assignments such as:

```
COMPLETE := FALSE
```

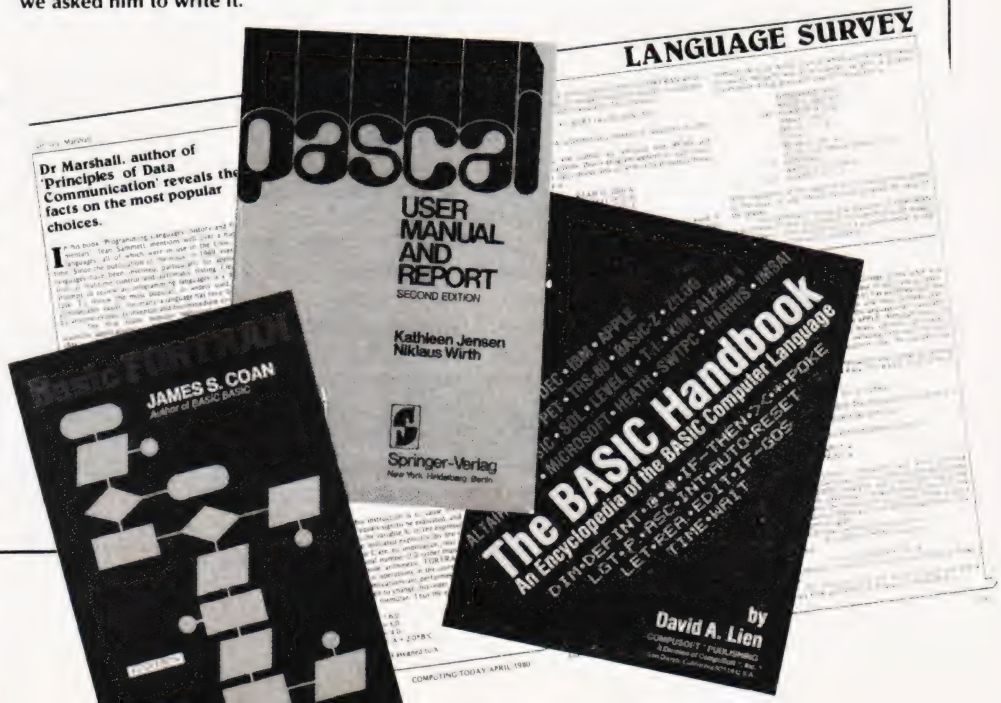
The algorithmic structures include the conditional IF — THEN — ELSE, the selector CASE OF, and, for repetition WHILE and REPEAT — UNTIL. There is a "pretty printing" feature in the language so that when programs are listed these structures are automatically indented. This also enhances program readability, but, more importantly, it provides a tremendously useful debugging aid, since incorrectly written structures can be found at once by examining the indentation arrangement.

The following example shows how the pretty printing feature displays a conditional statement.

```
IF RESPONSE$ = "NO" THEN
  PRINT "PROGRAM TERMINATES"
  FINISHED := TRUE
ELSE
  PRINT "WHICH JOB IS TO BE DONE
  NEXT?"
  INPUT JOB
ENDIF
```

The characteristic ENDIF to terminate an IF statement resurrects an idea from ALGOL 68, where, typically, the terminator for IF is FI.

Dr Marshall's original article on computer language sparked off so many requests for a series that we asked him to write it.



Procedures are supported by COMAL, rather than the subroutines of BASIC. A procedure call INITIALISE is declared by

```
PROC  INITIALISE
  TOTAL : = 0
  PRODUCT : = 1
  LINE : = 1
ENDPROC
```

It is executed by the statement

```
EXEC  INITIALISE
```

Recursion is supported, so that a procedure may call itself.

The array is the primary data structure available. A wide range of commands is available, which includes all those such as RUN, LIST and SAVE from BASIC, but adds automatic line number generation, line renumbering and others.

A COMAL Program

The following listing gives a fairly typical small COMAL program.

```
010   FINISHED : = FALSE
020   REPEAT
030     FOR I : = 1 TO 5 DO PRINT
040     PRINT " 1 = ADDITION"
050     PRINT " 2 = SUBTRACTION"
060     PRINT " 3 = MULTIPLICATION"
070     PRINT " 4 = DIVISION"
080     PRINT " 5 = STOP"
090     PRINT
100   INPUT " ENTER TYPE OF SUM
      REQUIRED " : TYPE
110   CASE  TYPE OF
120   WHEN  1
130     EXEC ADD
140     EXEC RECORD
150   WHEN  2
160     EXEC SUB
170     EXEC RECORD
.
.
.
240   WHEN  5
250     FINISHED : = TRUE
260   OTHERWISE
270     PRINT "NO SUCH COMMAND"
280   ENDCASE
290 UNTIL FINISHED
300 PROC ADD
310   N1 : = RND (40,50); N2 : = RND
      (1,10)
320   RESULT : = N1 + N2
330   SIGN$ : = " + "
340 ENDPROC ADD
```

This skeleton program should, I think, be sufficiently readable to convey that it is a maths drill program, with a menu and selector, to provide various arithmetic problems. The procedures for generating subtraction sums and the rest will be similar to ADD. The missing RECORD procedure would display the sum, accept the answer and keep a record of the student's performance. It might also analyse the student's record to determine strength and weaknesses.

Implementation And Availability

Commodore have an implementation of COMAL for the PET which they are releasing free, as public domain software, to educational users (see the April issue of Computing Today for further details). Borge Christensen has played a major part in developing COMAL for the PET, and the only shortcoming of the implementation that is worth mentioning is that it requires 26K of store, which leaves none too much space for the programmer.

There seems to be hardly any material on COMAL available in English (there is plenty in Danish!), but Commodore should be issuing fairly comprehensive documentation in conjunction with their COMAL.

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PROBLEM SOLVER

J N Rolinson

Solving the problem of Solitaire with a Vector Graphic

When the subject of home computers crops up, the one question that I hear most from the non-computing fraternity is... "but what can it do?" Financial reward from central heating control is somewhat of a fallacy and playing 'Star Trek' is, for many, a bit trivial. The ability of your dreamed of micro to solve actual problems may well be all that's needed for your wife, husband, mother etc. to view computing in the home in a new light.

For Christmas I received a puzzle that consists of fifteen marbles laid out as an equilateral triangle, a version of solitaire. Firstly, one marble is removed and the rest are jumped one over another into a vacant space beyond. The marble that has been jumped over is removed and the object is to leave just one marble remaining. I was unsuccessful for several days and my frustration was increased by knowing that my mother and father-in-law had both achieved it on Christmas day! I decided to write a program to find a solution (there is more than one possible solution). I was writing for a Vector Graphic MZ with Microsoft BASIC-80. The program listed uses a standard enough BASIC for it to be transferable to many micros. As it turned out I came across one solution the day before I ran the program but I carried on debugging it as it seemed a good exercise in problem solving programming.

```
          1
        2   3
      4   5   6
    7   8   9   10
 11   12  13  14   15
```

Fig.1 Lay out of the 15 numbered positions.

Positions

The fifteen positions of the marbles are defined as P(1−15) as shown, see Fig.1. In lines 40-50 — each position is made initially equal to 1 (ie presence of a marble). A position equal to 0 means no marble is present. Lines 70-80 remove one marble at random. Line 180 picks a further position and if a marble is present and has not yet been unsuccessfully looked at, then the various legal moves from that position are determined in lines 210-350. For a move to be successful, the position that the marble will move to must be vacant (line 370) and the position that it jumps over must contain a marble (line 380). If a successful move has been made, the position the marble moves to is termed AM(J) and the marble that has been jumped over is HOP(J). The state of those positions are redefined in line 400. Unsuccessful attempts to move a marble return the program to determining a new R(J) (ie a new position) and the unsuccessful position is labelled as "2" and is not bothered with until after the next successful move. After each move, the number of marbles left is determined as NL in line 110. If only one is remaining then the program branches to print statements. LPRINT causes hard copy print out but the solution could be displayed on a VDU as only seventeen lines are required. If the program finds that more than one marble is remaining but cannot proceed further then the random number seed is incremented by one and a new game is played. Z serves both as the seed and as a counter for the number of games played. CHR$(4) clears the screen allowing the game counter to be printed successively in the same position on the screen.

I found by chance that if the random number generator is seeded with seven then a solution is found on game number 30 (ie after 23 games). However, if the seed is input as one then it runs beyond 30 without a solution. The program ran slower than I had hoped, taking just under five minutes to find a solution. Can any reader come up with a quicker program to solve this puzzle?

Program Listing

```
10    INPUT "RANDOM NUMBER SEED";Z
20    DIM P(15):DIM M(5):DIM H(4):DIM AM(13):DIM HOP(13):DIM
      R(13)
30    RANDOMIZE Z
40    FOR X=1 TO 15
50    P(X)=1:NEXT
60    PRINT CHR$(4):PRINT "GAME NO. " Z:J=1
70    IR=INT((RND*15)+.5)
80    P(IR)=0
90    NL=0
100   FOR X=1 TO 15
110   IF P(X)=1 OR P(X)=2 THEN NL=NL+1
120   NEXT
130   IF NL=1 THEN 500
140   FOR X=1 TO 15
150   IF P(X)=1 THEN 180
160   NEXT
170   Z=Z+1: GOTO 30
180   R(J)=INT((RND*15)+.5)
190   IF P(R(J))=0 OR P(R(J))=2 THEN 180
200   M(3)=0:M(4)=0
210   IF R(J)=1 THEN M(1)=4:M(2)=6:H(1)=2:H(2)=3:GOTO 360
220   IF R(J)=2 THEN M(1)=7:M(2)=9:H(1)=4:H(2)=5:GOTO 360
230   IF R(J)=3 THEN M(1)=8:M(2)=10:H(1)=5:H(2)=6:GOTO 360
240   IF R(J)=4 THEN M(1)=1:M(2)=11:M(3)=6:M(4)=13:
      H(1)=2:H(2)=7:H(3)=5:H(4)=8:GOTO 360
250   IF R(J)=5 THEN M(1)=12:M(2)=14:H(1)=8:H(2)=9:
      GOTO 360
260   IF R(J)=6 THEN M(1)=1:M(2)=13:M(3)=15:M(4)=4:
      H(1)=3:H(2)=9:H(3)=10:H(4)=5:GOTO 360
270   IF R(J)=7 THEN M(1)=2:M(2)=9:H(1)=4:H(2)=9:GOTO 360
280   IF R(J)=8 THEN M(1)=3:M(2)=10:H(1)=5:H(2)=9:GOTO 360
290   IF R(J)=9 THEN M(1)=2:M(2)=7:H(1)=5:H(2)=8:GOTO 360
300   IF R(J)=10 THEN M(1)=3:M(2)=8:H(1)=6:H(2)=9:
      GOTO 360
310   IF R(J)=11 THEN M(1)=4:M(2)=13:H(1)=7:H(2)=12:
      GOTO 360
320   IF R(J)=12 THEN M(1)=14:M(2)=15:H(1)=13:H(2)=8:
      GOTO 360
330   IF R(J)=13 THEN M(1)=6:M(2)=11:M(3)=15:M(4)=4:
      H(1)=9:H(2)=12:H(3)=14:H(4)=8:GOTO 360
340   IF R(J)=14 THEN M(1)=5:M(2)=12:H(1)=9:H(2)=13:
      GOTO 360
```

```
350  M(1)=6:M(2)=13:H(1)=10:H(2)=14
360  I=1
370  IF P(M(I))<>0 THEN 460
380  IF P(H(I))=0 THEN 460
390  AM(J)=M(I):HOP(J)=H(I)
400  P(R(J))=0:P(M(I))=1:P(H(I))=0
410  J=J+1
420  FOR X=1 TO 15
430  IF P(X)=2 THEN P(X)=1
440  NEXT
450  GOTO 90
460  I=I+1
470  IF M(I)=0 THEN 490
480  GOTO 370
490  P(R(J))=2: GOTO 90
500  LPRINT "GAME NO." Z
510  LPRINT:LPRINT "FIRST REMOVE"IR:LPRINT
520  FOR X=1 TO (J-1)
530  LPRINT "MOVE FROM "R(X)" TO "AM(X)" REMOVE "HOP(X)
540  NEXT
550  END
```

SURROUND

Andrew Thomas

The classic arcade game on PET

This Surround program has been written for the PET and requires under 4K of memory. The game itself is based on the arcade game and, in this case, one of the players has been taken over by the computer. The object of the game is to stop your opponent from moving by surrounding him. On every move you must move onto a dot, trying to leave the screen will cause you to lose the game. At the beginning of the game there is a countdown shown by a shrinking rod on the bottom of the screen. The skill factor will alter the speed at which the program runs.

To alter the logic of the computer play the following notes should help.

X — is the position of your player.
X1 — is the position of the computer player.
Y — is the direction of your move.
Y1 — is the direction of the computer's move.

The A array stores the 4 directions in which it is possible to move and the 'dot' is character 46.

The remainder of the program is fairly straighforward and thus does not merit explanation.

Program Listing

```
1    PRINT" [CLS ]
10   PRINT TAB(15)"SURROUND"
20   PRINT TAB(15)"_ _ _ _ _ _ _ _ _"
30   PRINT
40   PRINT "THE OBJECT OF THIS GAME IS TO SURROUND"
50   PRINT "THE COMPUTER'S PLAYER IE TO STOP THE"
60   PRINT "COMPUTER FROM MOVING."
65   PRINT
70   PRINT "YOU MUST MOVE ONTO A DOT EVERY MOVE."
75   PRINT
80   PRINT "ONCE A DOT HAS BEEN COVERED YOU CANNOT"
90   PRINT "BACK TRACK ON TO IT."
95   PRINT
100  PRINT "THE COMPUTER WILL BE TRYING TO DO"
110  PRINT "THE SAME THING TO YOU."
120  PRINT
130  PRINT "THERE WILL BE A COUNT DOWN AT THE START"
140  PRINT "OF THE GAME."
150  PRINT
160  PRINT "YOUR CONTROL KEYS ARE 8-UP, 2-DOWN,"
170  PRINT "6-LEFT, 4-RIGHT."
180  PRINT
190  PRINT "HIT ANY KEY WHEN READY TO CONTINUE."
200  GET A$:IF A$="" THEN 200
210  PRINT
220  INPUT "YOUR SKILL RATING (1-9)";S
230  IF D<1 OR S>9 THEN PRINT "I SAID";:GOTO 220
240  S=S*10
300  A(1)=1
310  A(2)=-1
320  A(3)=40
330  A(4)=-40
340  X1=34359
350  Y1=A(RND(1)*4+1)
360  Y=1
370  X=34301
380  PRINT" [CLS ] [↑ 8 ] - COMPUTER SURROUND [↑ 2 ]-YOU"
390  FOR I=1 TO 23
400  PRINT "                                        ";
410  NEXT I
412  PRINT "                                        ";
414  POKE X,160
416  POKE X1,102
420  FOR I=0 TO 10
430  POKE 34791-I*40,118
440  NEXT I
450  FOR I=10 TO 0 STEP-1:FOR J=1 TO 200:NEXT J
460  POKE 34791-40*I,32:NEXT I
470  FOR I=1 TO S:NEXT I
480  GET A$
490  ON VAL(A$)/2 GOSUB 700,710,720,730
500  IF VAL(A$)<>0 AND RND(1)>.5 THEN Y1=-Y
510  X=X+Y
520  IF PEEK(X)<>46 THEN 650
530  POKE X,160
540  IF PEEK(X1+(3*Y1))<>46 THEN 580
550  IF RND(1)<.1 THEN Y1=A(RND(1)*4+1)
560  X1=X1+Y1:IF PEEK(X1)=46 THEN POKE X1,102:GOTO 470
570  X1=X1-Y1
580  R=RND(1)*4+1:IF PEEK(X1+A(R))=46 THEN
     Y1=A(R):GOTO 560
590  IF PEEK(X1+1)=46 THEN Y1=1:GOTO 560
600  IF PEEK(X1-1)=46 THEN Y1=-1:GOTO 560
610  IF PEEK(X1+40)=46 THEN Y1=40:GOTO 560
620  IF PEEK(X1-40)=46 THEN Y1=-40:GOTO 560
640  PRINT "YOU WIN !!!!!!!!!";:GOTO 670
650  PRINT "YOU LOSE !!!!!!!!!";
670  INPUT "ANOTHER GAME";Q$
680  IF LEFT$(Q$,1)="Y"THEN S=S-5:GOTO 340
690  GOTO 999
700  Y=40:RETURN
710  Y=-1 :RETURN
720  Y=1 :RETURN
730  Y=-40:RETURN
999  PRINT" [CLS ]":END
```

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The course consists of a book and a cassette of programs, and has been designed to supplement the Sinclair manual. It is assumed that this has already been studied, and that the reader is capable of constructing very elementary programs. In our book, the ZX80's BASIC is explained in more detail, with special attention being given to those aspects likely to cause difficulty, for example, the use of PEEK and POKE and the USR function. An introduction to machine code is given removing some of the mystery which surrounds this subject, and there is also a section explaining the workings of the Z80 microprocessor.

The accompanying cassette contains ready to run programs, which are dealt with in the text, which also includes many other useful programming examples. The emphasis is on understanding, and the course should give you the confidence to construct your own involved programs, thereby getting the most out of your ZX80.

BUG-BYTE SOFTWARE

251 HENLEY ROAD COVENTRY CV2 1BX

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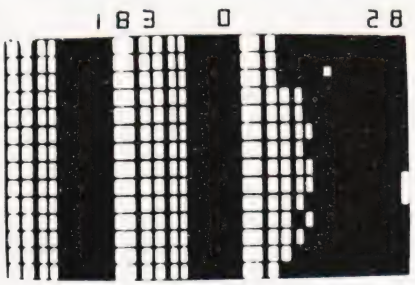

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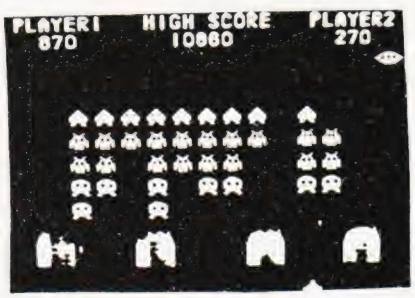

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MULTI PURPOSE INTERFACE

P A Forrester

Make more of your micro's control capabilities with this simple but effective unit.

Many eight-bit microcomputers such as the PET, NASCOM 2, AIM-65, Acorn ATOM and others, are fitted with a Programmable Input/Output chip (PIO) which controls two output ports. In some machines this chip is called a Peripheral or Versatile Interface Adaptor (PIA or VIA), but both perform basically the same function, and in the following all such chips will be referred to generically as PIOs. With the two ports used in the output mode, up to 16 individual circuits, such as LEDs, relays, lights or motors, can be controlled by sending the appropriate bit patterns to the ports. What do you do if you wish to control more than 16 circuits? One solution is to add additional PIOs to the system, but this may not be too easy, particularly on a single board computer, and at best would probably involve the use of an extra board connected to the system via the bus. However, using some TTL latches built on a separate board and connected only to the output ports and the source of power, the control capability of the microcomputer can be considerably extended. This article describes how this can be achieved.

Time Multiplexed Latching

The additional circuitry is built around the 74LS75 four-bit latch. The TTL latch is chosen because it is very inexpensive at about 30p to 40p per package if you shop around. There are eight-bit latches available which are designed specifically for microcomputer use, such as the Intel 8212, these are significantly more expensive, at between £2 to £3 each. However, other types of latch could be used following the scheme described below if you have a ready supply available. Figure 1 gives the pin layout of the 74LS75. With a positive voltage of greater than 2 V on the chip enable pins (4 and 13), the outputs Q1 to Q4, follow the inputs D1 to D4, and their inverse appears at Q1 to Q4. At the instant that the enable voltage is removed, the outputs cease to follow the input and stay locked to the value they had immediately prior to being disabled. Two such devices can be used to remember the state of an eight-bit output port on any desired time simply by pulsing the enable pin with a suitable positive voltage for a time in excess of 20 nS. The use of only two latches does not give any additional capability since the outputs of the PIO are latched internally anyway, but suppose we now take 16 74LS75 latches and parallel feed them in pairs from a single eight-bit port. We can then feed different bit patterns into each pair of latches by enabling them at different times. Each pair can be enabled by supplying it with a voltage derived from one of the bits of the second PIO port. The only slight penalty which is paid for this extra capability is that additional instructions have to be sent to latch each byte but this loss of speed is hardly likely to be significant for most applications. Figure 2 shows how the circuit is set up, to avoid

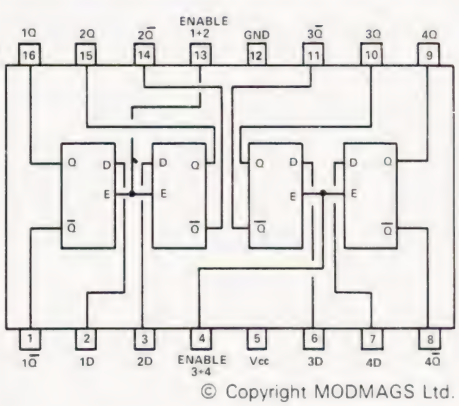


Fig.1. The pin-out of the 74LS75

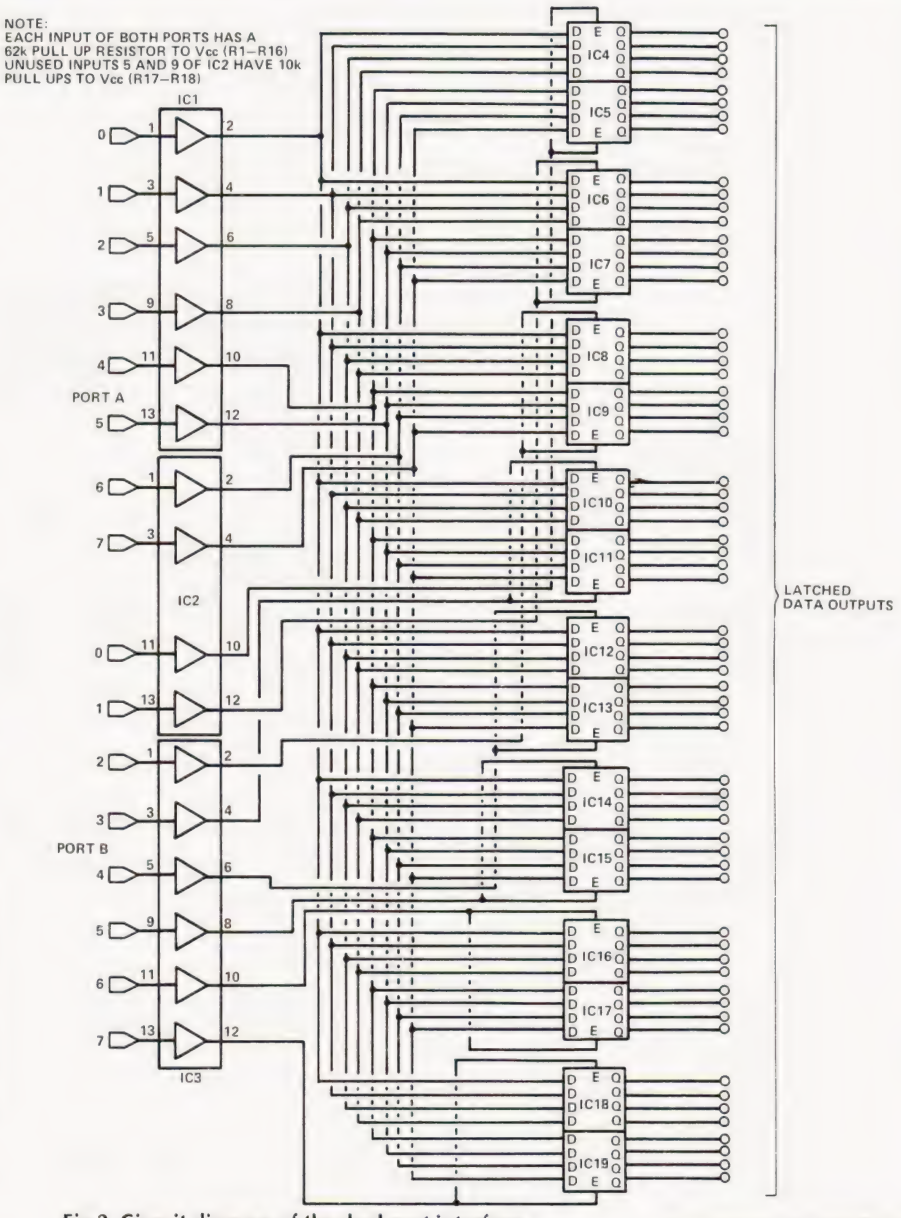


Fig.2. Circuit diagram of the dual port interface

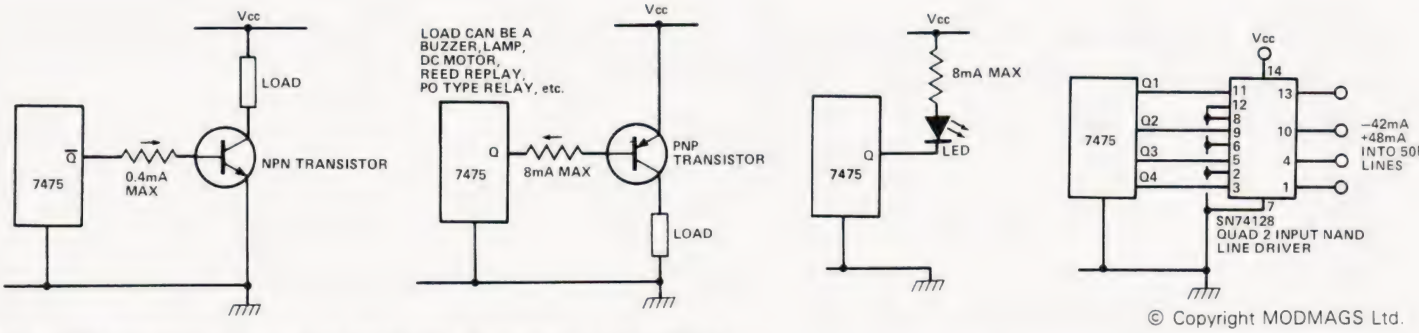


Fig.3. Some suggested ways to drive loads from the outputs of the interface

overloading the port drivers the inputs to the 74LS75s are fed through 74LS04 inverting buffer amplifiers. The outputs are shown schematically and can be taken from either the Q or $\overline{Q}$ outputs as appropriate. In the high state, TTL logic is only capable of sourcing about 0.4 mA but this is sufficient to drive a small transistor to switch, for example, a relay. When the Q output is high, the corresponding $\overline{Q}$ output is low and can be used to sink up to 8 mA from the +5 V line through, for example, and LED. Some suggested ways of coupling to the Q and $\overline{Q}$ outputs to activate a load when a positive voltage from the port has been latched are shown in Fig. 3. Note that because of the inversion produced by the buffers it is the $\overline{Q}$ output which follows the data input.

Constructing The Interface

It would be convenient to lay out the board in a similar way to that shown in the circuit diagram so that there were two rows of 64 pins each for the Q and $\overline{Q}$ outputs. However, unless you have facilities for etching your own circuit boards, this is not easy to achieve, and I chose to construct my interface on a

Parts List

Semiconductors

IC1-3	**SN74LS04 Hex Inverting Buffers**
IC4-19	**SN74LS75 4-Bit Latches**

Resistors ¼W, 5%

R1-16	**62k**
R17,R18	**10k**

Capacitors

C1-5	**47nF 12 V Ceramic**

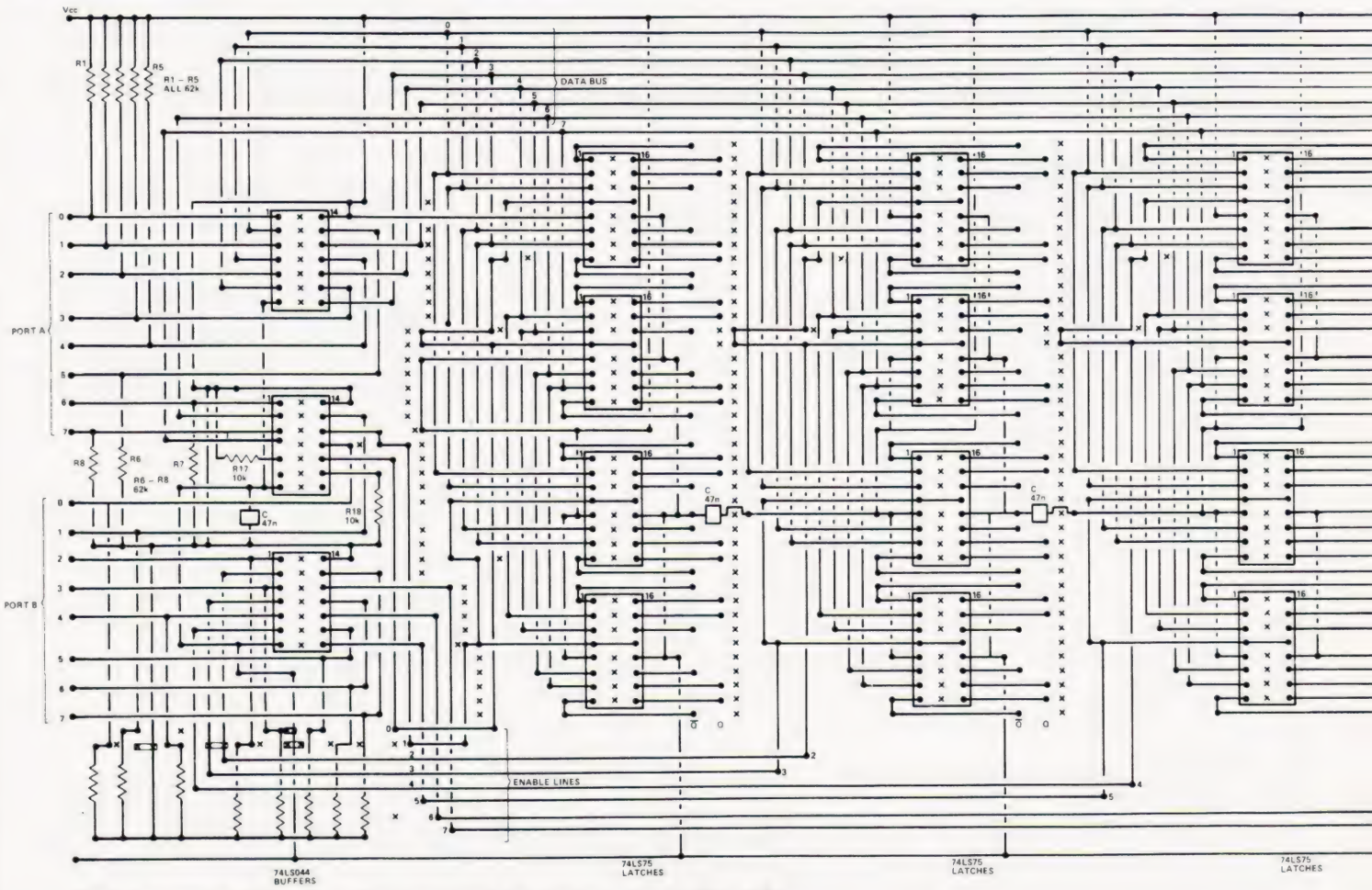


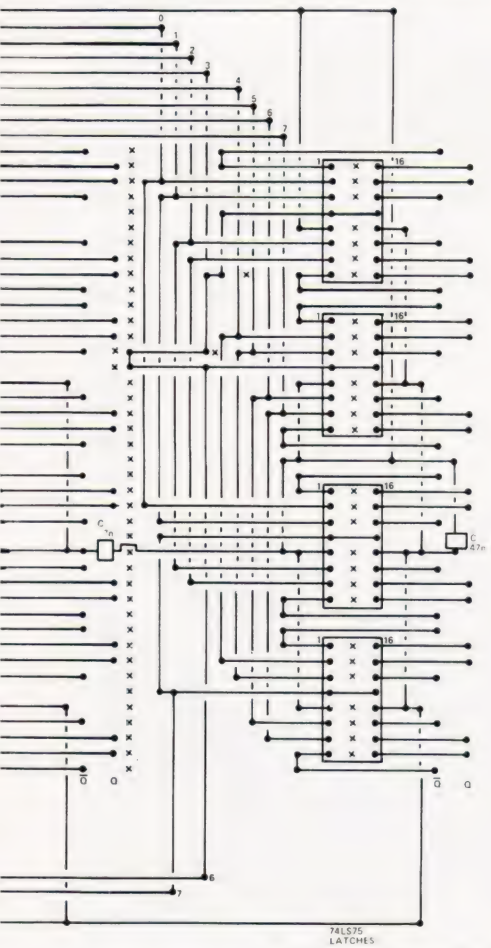
Fig.4. A suggested wiring layout for Veroboard, the tracks run from left to right

large piece of Veroboard. The latches were laid out in four blocks of four, with the output pins adjacent to each block; the Q and $\overline{Q}$ pins were staggered slightly to avoid confusion. Fig. 4 gives a wiring layout.

Note the pull-up resistors connected to the inputs of all the buffer amplifiers. When the computer is first switched on, before the PIO has been set to the output mode, the ports are in the high impedance state. Without the pull-up reistors, the logic values of the inputs to the interface would be indeterminate and it would be possible for all the output lines to be activated unintentionally. By pulling the inputs of the buffers to logic one, we ensure that the enable lines are deactivated and the data input to the latches is low upon switching on.

Note also that the two unused inputs to the centre 'LS04 have been tied to V_{cc} through 10k resistors. 47 nF capacitors have been added to each block of ICs to prevent accidental latching by supply induced transients.

I have suggested that LS versions should be used because they have a relatively small current consumption, but it would be possible to use the other versions if you prefer. The 7475 outputs are capable of sinking up to 16 mA, but on average these chips consume between four to five times as much current as the LS versions, Also, according to the maker's specification, the enable lines could require more drive current than the buffers are capable of supplying. Thus, to drive 7475 latches with absolute confidence you should either buffer each latch separately rather than in pairs, or use a buffer, such as the 7428 or 7438, with a larger drive capability. Note, however, that these ICs are *not* pin-compatible with the 7404. With the LS version, the maximum current required from the board would be 212 mA; you then have to add whatever current is needed to drive your loads — do not forget that 64 LEDs taking only 8 mA each will require over half an amp if switched on simultaneously! The prototype took 162 mA using LS versions and 580 mA using straight TTL (excluding loads). You should make sure that your computer power supply is capable of providing the additional current; otherwise use a separate power source.



Software Control

So how do we program our new interface to control all these output lines? This can be done either by a program written either in BASIC or machine code, and examples of both are given below. At the machine code level, there are small differences between a PIO and a PIA or VIA; the PIO is used with 8080 and Z80 microprocessors and is addressed by a special OUT instruction, whereas the PIA/VIA, which is used, for example, with 6502 based systems, is treated as just another set of addresses in memory. In the discussion below, we shall use the PIO as our example — translation to the use of the PIA/VIA is straightforward. The first step is to send a byte to the control registers of the PIO to set Ports A and B into the output mode. You have to know the addresses of the registers, and the correct byte for your particular PIO; you then send an OUT instruction. Table 1 gives the addresses used by several different microcomputers for these control registers, and also the addresses of the A and B Ports. The PET is somewhat different in that it has one eight-bit port available from the Parallel User Port (J2), and a second from the IEEE-488 Port (J1); note, however, that the protocol for using the IEEE Port must be observed and that it uses inverted logic. Nick Hampshire's book "The PET Revealed" gives some excellent guidance upon the uses of these ports.

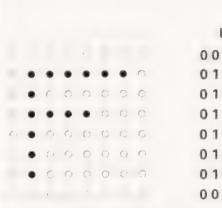
Let us take the NASCOM 2 as an example. We see that the control register addresses are 06H and 07H, and, using the Mostek MK3881 PIO, the required bit pattern is 0 0 0 0 1 1 1 1 (OFH), so the first instruction is LD A,OFH:OUT(06),A; OUT(07),A in assembly language, or OUT 6,15;OUT 7,15 in BASIC. In mode 0 of the MK3881 PIO, bits sent to the output ports are latched there until they are changed by a subsequent OUT instruction. These two control bytes only need to be sent once at the beginning of the program to initialise the ports. We are then ready to use our output board. Suppose that we wish to set the low nibble of the third latch to 0 0 0 0 1 0 1 0 (0A Hex). Continuing with the NASCOM 2 as our example, we see that the address of Port A is 04H, and that of Port B is 05H. We set up Port A to 0AH by the instructions LD A,0AH; OUT(04), A in assembly language (or 3E 0A D3 04 in Z80 object code). In BASIC the corresponding instruction is OUT 4,10. To activate the third latch, we need to set bit 2 (that is the third bit when counting the first bit as zero) of Port B to a logic 1, and then immediately reset it to 0. We do this by the instructions LD A,FBH;OUT(5),A;LD A,FFH;OUT(5), A in assembly code which generates 3E FB

COMPUTER	PORT A ADDRESS		PORT B ADDRESS		CONTROL REGISTER ADDRESS FOR PORT A		CONTROL REGISTER ADDRESS FOR PORT B		BYTE TO SET PORTS INTO OUTPUT MODE		COMMENTS
	HEX	DEC	HEX	DEC	HEX	DEC	HEX	DEC	HEX	DEC	
ACORN ATOM	B801	47105	B800	47104	B803	47107	B802	47106	FF	255	REMOVE PRINTER DRIVE ROUTINE BY !#208 = !#208 + 3 TURN OFF HANDSHAKE WITH ?#B80C = 0
ROCKWELL AIM–65	A00F	40975	A000	40960	A003	40963	A002	40962	FF	255	
NASCOM–2	04	4	05	5	06	6	07	7	0F	15	
COMMODORE PET	E84F	59471	E822	59426	E843	59459	IEEE-488 PORT SEE TEXT		FF for PORT A	255	PORT A IS FROM THE VIA AND IS STRAIGHT–FORWARD TO USE. PORT B IS FROM NO.2 PIA AND IS SET UP AS THE IEEE-488 PORT
TANGERINE MICRON & MICROTAN –65 WITH TANEX EXPANSION	BFC1	49089	BFC0	49088	BFC3	49091	BFC2	49090	FF	255	THESE MACHINES HAVE TWO VIAS, AND THUS 32 OUTPUT LINES. WITH TWO INTERFACE BOARDS THIS COULD BE INCREASED TO 128!
	BFE1	49121	BFE0	49120	BFE3	49123	BFE2	49122	FF	255	

Table 1. The output port addresses of some popular microcomputers

D3 05 3E FF D3 05 as the object code, or OUT5,251:OUT5,255 in BASIC. Note that, because the buffers invert the data from both ports, the program has to re-invert the bit pattern for the enable lines, but the data can be taken with the correct polarity from the Q output.

As a more complicated example, imagine that we wish to use the eight latched outputs to control an eight by eight array of LEDs, with the top row controlled by the first latch (enabled by bit 0 of Port B) and so on to the bottom row (enabled by bit 7). If we wished to write a letter F on the array we could set the eight bytes to the values shown in Fig. 5, and this is achieved by the BASIC listing given below which winks the display on and off at approximately once a second.



REPRESENTATIONS		
BINARY	HEX	DECIMAL
00000000	00	0
01111110	7E	126
01000000	40	64
01111000	78	120
01000000	40	64
01000000	40	64
01000000	40	64
00000000	00	0

Fig.5. Demonstrating the interface with an eight by eight LED display

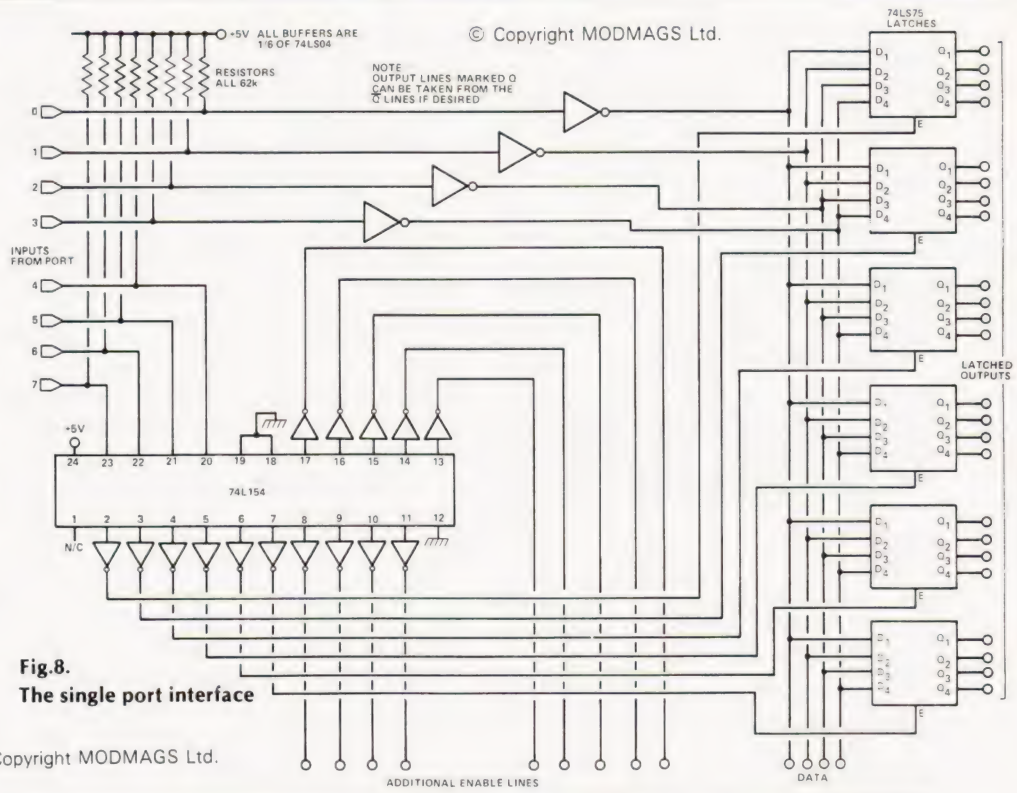


Fig.8. The single port interface

By using the more extended data statement starting at line 180, which can be accessed by setting B to 1 on entry, an alternative message can be displayed. Can you work out what it is?

For those who prefer to program in Z80 assembly language the other listing, which does not use any monitor subroutines, displays the longer message sequence given in the BASIC program.

An Alternative Latching Technique

Some machines have only one output port available for external use and reserve the second port generated by the PIO for other operations, such as cassette tape interfacing and control or for creating a pseudo-serial port. However, by using only a few additional TTL chips it is possible to obtain almost as large an output addressing capability as with the scheme described above from only a single port. The idea is to use the low nibble of the output port to feed data into the latches, and to use the upper nibble with a decoder to obtain the enable lines. The main additional chip required to achieve this is a 74L154 (a 4 line to 16 line decoder) and the pin layout is shown in Fig.6. The circuit of Fig.7 shows how the scheme is implemented. The upper four bits of the port are fed into the decoder which activates one output line for each combination of the four inputs — 0000 activating line 0, 0001 activating line 1, and so on, up to 1111 activating line 15. Input line A corresponds to bit 4 and line D to bit 7. Note that the 74L154 gives an active low, so that all output lines from the decoder are normally in the high state, except the active one, and the lines must be inverted by 74LS04 buffers before application to the 74LS75 enable pins. Line 0 should be left unused so that when it is activated, all the latches are disabled. As before, the data lines, which are connected to the lower four bits of the port, are buffered by 74LS04s, but the inputs to the 74L154 do not need to be buffered.

The method of driving the interface with a software routine is similar to that described above, except that now the data and the enable decode inputs have all to be packed into a single byte.

Since there are 15 usable lines available from the decoder, up to 60 output lines can be controlled by this method from a single port, at the expense of a little bit more complexity in the hardware and software.

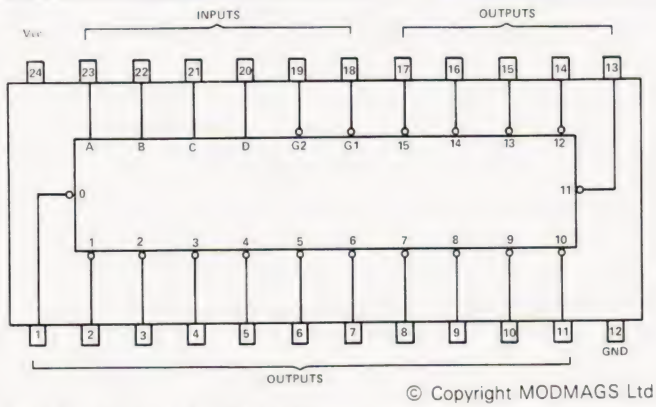
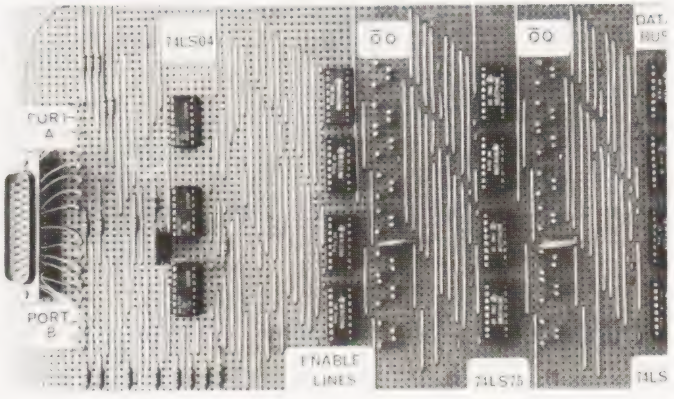


Fig.6. The pin out of the 74L154



A prototype of the interface constructed on Veroboard

Program Listing

```
                        0010  ;*********************************
                        0020  ;*      Z-80 Assembly Language   *
                        0030  ;*      Program to Demonstrate   *
                        0040  ;*          the use of the       *
                        0050  ;*      Programmable Interface   *
                        0060  ;*********************************
                        0070  ;Set these bytes for
                        0080  ;your particular PIO
2000                    0090          ORG 2000H
2000  00 06            0100  CONPA   EQU 6
2000  00 07            0110  CONPB   EQU 7
2000  00 04            0120  PORTA   EQU 4
2000  00 05            0130  PORTB   EQU 5
2000  00 0F            0140  CBYTE   EQU 0FH
2000  00 08            0150  COUNT   EQU 8
2000  00 80            0160  NOBYS   EQU 128 : length of
                        0170  ;             data table
                        0180  ;SET UP PORTS TO OUTPUT MODE
2000  3E 0F            0190          LD A,CBYTE
2002  D3 06            0200          OUT (CONPA),A
2004  D3 07            0210          OUT (CONPB),A
2006  DD21 3D 20        0220  START   LD IX,TABLE
200A  16 00             0230          LD D,0:Initialise
200C  1E 00             0240          LD E,0:counters
200E  2E 01             0250          LD L,1
2010  14                0260  REPEAT  INC D
2011  DD66 00           0270          LD H,(IX)
2014  3E 80             0280          LD A,NOBYS
2016  BB                0290          CP E
2017  28 ED             0300          JR Z,START;jump back
2019  1C                0310          INC E ; if at end of
201A  7C                0320          LD A,H ; data table
201B  EE FF             0330          XOR 0FFH
201D  D3 04             0340          OUT (PORTA),A
201F  7D                0350          LD A,L
2020  EE FF             0360          XOR 0FFH
2022  D3 05             0370          OUT (PORTB),A ; latch
2024  EE FF             0380          XOR 0FFH
2026  07                0390          RLCA ;increase enable
2027  6F                0400          LD L,A; by 2, then
2028  3E FF             0410          LD A,0FFH ; put back
202A  D3 05             0420          OUT (PORTB),A ; in L
202C  DD23              0430          INC IX
202E  3E 08             0440          LD A,COUNT
2030  92                0450          SUB D
2031  20 DD             0460          JR NZ,REPEAT;skip if
2033  2E 01             0470          LD L,1 ;eight byte
2035  16 00             0480          LD D,0 ;move to next
2037  CD BD 20          0490          CALL DELAY ;data byte
203A  18 D4             0500          JR REPEAT
203C  76                0510          HALT
023D  00 1C 22 40       0520  TABLE   DEFB 00 1CH 22H 40H
2041  40 40 22 1C       0530          DEFB 40H 40H 22H 1CH
2045  00 1C 22 41       0540          DEFB 00 1CH 22H 41H
2049  41 41 22 1C       0550          DEFB 41H 41H 22H 1CH
204D  00 82 C6 AA       0560          DEFB 00 82H C6H AAH
2051  92 82 82 82       0570          DEFB 92H 82H 82H 82H
2055  00 3C 22 22       0580          DEFB 00 3CH 22H 22H
2059  3C 20 20 20       0590          DEFB 3CH 20H 20H 20H
205D  00 42 42 42       0600          DEFB 00 42H 42H 42H
2061  42 42 24 18       0610          DEFB 42H 42H 24H 18H
2065  00 7F 08 08       0620          DEFB 00 7FH 08H 08H
2069  08 08 08 08       0630          DEFB 08H 08H 08H 08H
206D  00 08 08 08       0640          DEFB 00 08H 08H 08H
2071  08 08 08 08       0650          DEFB 08H 08H 08H 08H
2075  00 41 61 51       0660          DEFB 00 41H 61H 51H
2079  49 45 43 41       0670          DEFB 49H 45H 43H 41H
207D  00 1C 22 40       0680          DEFB 00 1CH 22H 40H
2081  46 42 22 1C       0690          DEFB 46H 42H 22H 1CH
2085  00 00 00 00       0700          DEFB 0 0 0 0 0 0 0 0
      00 00 00 00
208D  00 7F 08 08       0710          DEFB 00 7FH 08H 08H
2091  08 08 08 08       0720          DEFB 08H 08H 08H 08H
2095  00 1C 22 41       0730          DEFB 00 1CH 22H 41H
2099  41 41 22 1C       0740          DEFB 41H 41H 22H 1CH
209D  00 78 44 42       0750          DEFB 00 78H 44H 42H
20A1  42 42 44 78       0760          DEFB 42H 42H 44H 78H
20A5  00 18 24 42       0770          DEFB 00 18H 24H 42H
20A9  7E 42 42 42       0780          DEFB 7EH 42H 42H 42H
20AD  00 82 44 28       0790          DEFB 00 82H 44H 28H
20B1  10 10 10 10       0800          DEFB 10H 10H 10H 10H
20B5  00 00 00 00       0810          DEFB 0 0 0 0 0 0 0 0
      00 00 00 00
                        0820  ;One Second Delay Routine
20BD  C5                0830  DELAY   PUSH BC
20BE  06 03             0840          LD B,3H
20C0  3E FF             0850  DLY3    LD A,0FFH
20C2  0E FF             0860  DLY2    LD C,0FFH
20C4  0D                0870  DLY1    DEC C
20C5  20 FD             0880          JR NZ,DLY1
20C7  3D                0890          DEC A
20C8  20 F8             0900          JR NZ,DLY2
20CA  05                0910          DEC B
20CB  20 F3             0920          JR NZ,DLY3
20CD  C1                0930          POP BC
20CE  C9                0940          RET
```

The Z80 code listing for a Nascom that drives an eight by eight LED matrix display

```
 50 REM **B should be set to 0 on entry for the
 60 REM **short demonstration and to 1 for the
 70 REM **longer message.
 80 INPUT "B =";B: IF B>1 GOTO 80
 90 OUT 6,15: OUT 7,15: REM **Set Ports to Output
100 A=0: C=0: ON B GOTO 220
110 REM **A counts when all the DATA in line 150
120 REM **has been used, and C counts the number
130 REM **of characters generated by the data
140 REM **starting at line 270
150 DATA 0,126,64,120,64,64,64,0,0,0,0,0,0,0,0
160 FOR I=1 TO 8
170 READ J: J=256+NOTJ: REM** Invert DATA Bits
180 OUT 4,J:OUT 5,256+NOT (2↑(I-1)):OUT5,255
190 NEXT I
200 FOR K=1 TO 500: NEXT K: REM**Wait a while
210 C=C+1
220 ON B GOTO 280
230 A=A+1
240 IF A<2 GOTO 150
250 RESTORE 90
260 GOTO 100
270 DATA 0,28,34,64,64,64,34,28
280 DATA 0,28,34,65,65,65,34,28
290 DATA 0,130,198,170,146,130,130,130
300 DATA 0,60,34,34,60,32,32,32
310 DATA 0,66,66,66,66,66,36,24
320 DATA 0,127,8,8,8,8,8,8
330 DATA 0,8,8,8,8,8,8,8
340 DATA 0,65,97,81,73,69,67,65
350 DATA 0,28,34,64,70,66,34,28
360 DATA 0,0,0,0,0,0,0,0
370 DATA 0,127,8,8,8,8,8,8
380 DATA 0,28,34,65,65,65,34,28
390 DATA 0,120,68,66,66,66,68,120
400 DATA 0,24,36,66,126,66,66,66
410 DATA 0,130,68,40,16,16,16,16
415 DATA 0,0,0,0,0,0,0,0
420 IF C=0 THEN RESTORE 270
430 IF C<16 GOTO 160
440 C=0: GOTO 420
450 GOTO 160
460 END
```

A BASIC listing to perform the same function

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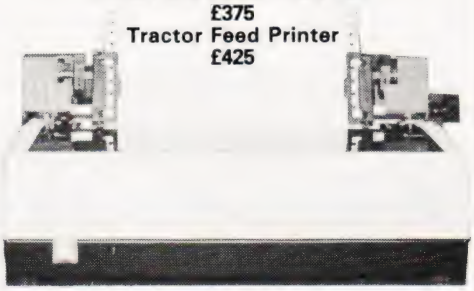

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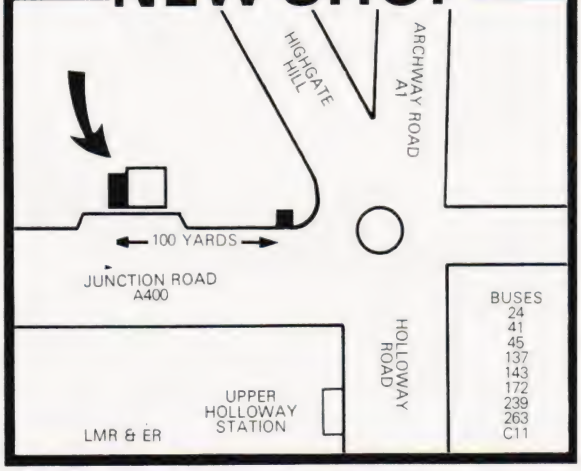

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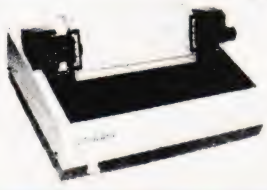

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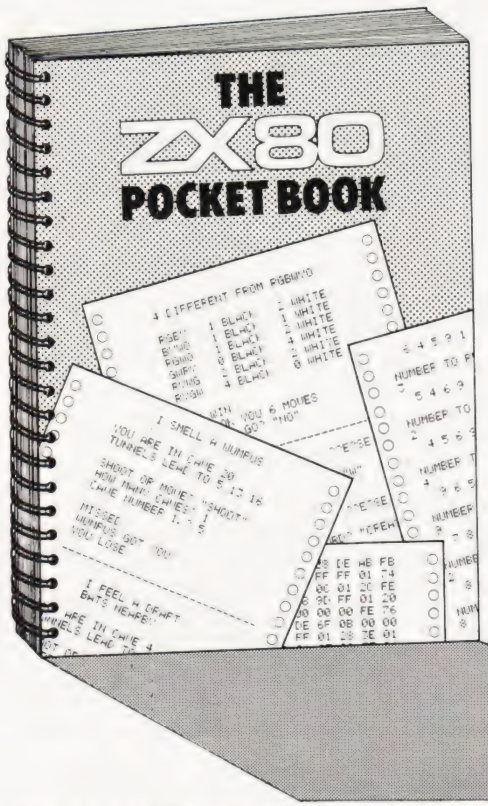

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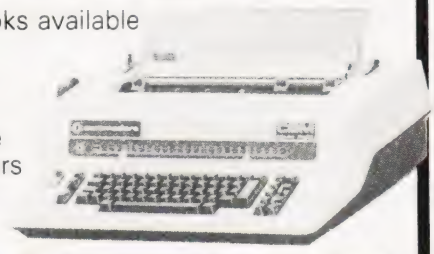

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U — This causes the aircraft to go up.

D — This causes the aircraft to go down.

L — This causes the aircraft to level out.

B — This causes the bomb to be dropped.

Once the bomb has dropped it will fall in a parabolic arc towards the water; it will continue to bounce along the surface of the water until the maximum height of the bounce drops below a certain point. In order to destroy the dam the bomb must strike it at an angle of ± 45 degrees.

When the first aircraft has either crashed (by going too low or flying off the end of the screen) or destroyed the dam, a new target will be displayed and the second aircraft will appear.

When all three aircraft have been used the player's score will be displayed. (Graphics are for the PET).

Program Listing

```
000 DIM X(2),H(2),P(2)
005 PRINT" [CLS ]"
010 W=0:G=0:T=0
015 PRINT" [HOM ]"
020 IF G=3 THEN 455
025 D=0:C=0:S=0:Y=0
030 FOR A=1 TO 40
035 POKE 33727+A,96
040 NEXT A
045 FOR A=1 TO 3
050 FOR B=1 TO 7
055 POKE 33437+A+40*B,96
060 NEXT B
065 NEXT A
070 FOR A=1 TO 30
075 POKE 33527+A,99
080 NEXT A
085 IF C=1 THEN 100
090 C=1:H(1)=INT(RND(1)*16)
095 X(1)=0
100 IF Y=1 THEN 215
105 IF H(1)<2 THEN PRINT"DANGER-TOO LOW":
    PRINT" [HOM ]"
110 IF H(1)<0 THEN 410
115 X(1)=X(1)+1
120 IF X(1)>39 THEN 425
125 P(1)=32768+X+40*(16-H(1))
130 POKE P(1),96
135 POKE P(1)+1,96
140 IF D=1 THEN POKE P(1)+2,99:GOTO 150
145 POKE P(1)+2,96
150 POKE P(1)+3,96
155 POKE P(1)+4,100:POKE P(1)-40,96
160 IF D=1 THEN 215
165 GET A$
170 FOR B=1 TO 30:NEXT B
175 IF A$="" THEN 105
180 IF A$="D" THEN H(1)=H(1)-1:GOTO 105
185 IF A$="B" THEN 210
190 IF H(1)>15 THEN A$="L"
195 IF A$="L" THEN 105
200 IF A$="U" THEN H(1)=H(1):GOTO 105
205 GOTO 105
210 F=H(1):D=1:X(2)=X(1)
215 IF F<2 THEN 380
220 S=S+1
225 H(2)=INT(F-S*S*0.5)
230 X(2)=X(2)+1
235 IF X(2)>30 THEN 275
240 P(2)=32768+X(2)+40*(16-H(2))
245 POKE P(2),96
250 IF H(2)<-1 THEN 260
255 GOTO 100
260 F=INT(3*F/4+0.5)
265 S=-INT(SQR((F+2)*2)+0.5)
270 GOTO 100
275 G=G+1
280 POKE P(2),32
285 FOR A=1 TO 4
290 POKE P(1)-1+A,32
295 NEXT A
300 POKE P(1)-40,32
305 IF H(2)>0 THEN 15
310 IF (S<-1)OR(S>1) THEN 15
315 FOR A=1 TO 3
320 FOR B=1 TO 3
325 POKE 33437+40*B+A,32
330 NEXT B
335 NEXT A
340 POKE 33599,32
345 POKE 33600,32
350 POKE 33639,32
355 FOR A=1 TO 40
360 POKE 33527+A,99
365 NEXT A
370 T=T+1
375 GOTO 15
380 FOR A=1 TO 5
385 POKE P(2)+40*A,96
390 FOR B=1 TO 15:NEXT:B
395 NEXT A
400 POKE P(2)+200,32
405 GOTO 15
410 PRINT"TOO LATE-YOU HAVE CRASHED!"
415 W=W+1
420 FOR A=1 TO 4
425 POKE P(1)-1+A,32
430 NEXT A
435 POKE P(1)-40,32
440 IF D=0 THEN G=G+1:GOTO 15
445 Y=1
450 GOTO 215
455 PRINT"YOU HAVE LOST "W" AIRCRAFT."
460 PRINT"YOU HAVE DESTROYED "T" DAMS."
465 PRINT"THEREFORE YOUR SCORE IS "T-W
470 INPUT"DO YOU WANT ANOTHER GAME?"B$
475 IF B$="YES" THEN 5
480 STOP
```

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ZX80 BOOK SURVEY

Despite last month's release of the ZX81 the books on Sinclair's ZX80 just keep on coming. We take a look at what's available and see whether they live up to the claims they make.

The ZX80 has now been on the scene for sufficient time to have encouraged the development of its own group of users, not only as individuals but also active groups/clubs. It has at least two regular monthly magazines/newsletters that are aimed primarily at the ZX80 user. As one would expect in this age of technology, with highly developed communications systems, books about the ZX80 have rapidly appeared in the shops. This article will briefly try to give you an idea of what some of them contain and hopefully help you in your choice.

The books fall into two main categories. those that are primarily books of programs for use on the ZX80 and those that additionally set out to teach the reader more about the operation of the ZX80.

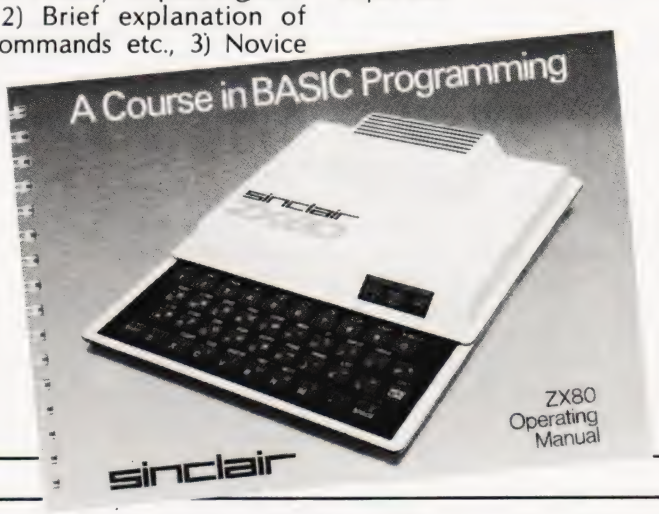
The ZX80 by virtue of its low cost has attracted a very large number of purchasers. These range from those with little or no prior knowledge of computers to those who have a clear understanding of the internal workings of computers. The requirements of these various levels of user are quite different and although it is an admirable concept on the part of the author to coach the former to the level of the latter, I feel that this approach must be taken with extreme care in consideration for the reader's capabilities. The ZX80, more than any other micro on the market at the present, is being used by newcomers to this field. They are hungry for information, let us hope they do not get indigestion!

The ZX80 Manual

One presumes that the potential readers of these books already have a ZX80 or are seriously considering getting one. This means that they have or will shortly have the Operating Manual that is supplied with the machine. This is 128 pages long and starts with Chapter One instructing the reader to read Chapter Two first! Chapter One (half a page) explains the somewhat novel approach that the author, Hugo Davenport, has used for this manual. The less experienced reader is given the option of reading even numbered chapter headings to achieve a rapid 'hands on' introduction to using his ZX80. The manual recognises that many of the users will have little previous knowledge and attempts to introduce the various operations in a simple manner. Like many other operating manuals it tends to fall into the trap of over-simplification on the one hand and the introduction of terms the newcomer will find difficult to understand on the other. In fairness to Sinclair, the operating manual is better than some I have seen and does enable the user with a little knowledge to start using his ZX80 fairly sensibly.

The question it raises is 'how much should an operating manual tell the reader'? Is it to be instruction on the use of the machine or is it to teach you what you can do with the machine? With such a wide range of possible uses that a computer can be put to, it would be unfair to expect detailed information on more than a limited number of uses/programs. This leaves the user to develop his own solutions for his particular requirements: be they games, teaching routines or solutions to lengthy mathematical problems. In my opinion the layout of the operating manual would be clearer to all if it had a more conventional approach: 1) What to do when initially unpacking/switching on, 2) Brief explanation of keyboard commands etc., 3) Novice 'hands on' operating chapters, 4) Expansion of these chapters in same sequence as 3), 5) Advanced user information, 6) Appendices, tables, error codes etc.

The user of the ZX80 having worked his way through the manual will then want to expand his knowlege, be he novice or expert, by 1) learning/writing further programs and 2) consolidating his existing understanding of what the ZX80 can achieve. This is where we came in! The books now available for the ZX80 user give him not only the opportunity to expand his program library but also cater for several levels of user expertise.



Learning BASIC With Your Sinclair ZX80 (Newnes Technical Books) by Robin Norman,
Published by Newnes Technical Books
ISBN 408 011017, 160 pages £3.95

In the preface Mr Norman says 'In writing this book I have made three assumptions . . .

1) He (the reader) is a newcomer to computer programming . . .

2) He has one particular microcomputer, the Sinclair ZX80, switched on, in front of him.

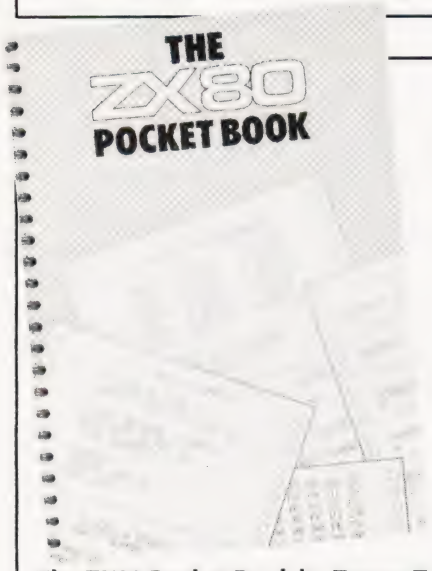
3) He wants to learn all the instructions available in ZX80 BASIC, using a structured course with a steadily increasing tempo . . .

A clear statement of intent, that is

followed by twenty-five chapters and five appendices that completely live up to, and validate, the original assumptions.

In the first two chapters Mr Norman very briefly outlines what a computer is and how we 'talk to' computers. From Chapter 3 to Chapter 25 the reader is led carefully and sytematically through all the BASIC commands and statements available to the ZX80. Mr Norman's style is easy to read and the entire learning process is based on a 'hands on' approach. The examples given are easy to understand and a number of problem exercises are set throughout the book, the answers being supplied in Appendix 4.

Appendix 1 lists all the ZX80 BASIC commands and statements for the 4K ROM, together with a very brief explanation of each. Appendix 2 gives a useful 'Glossary of Terms' explaining the meaning of a number of computer terms that often baffle the newcomer. Appendix 3 consists of fourteen specially written program listings together with notes on each. These range from a number of interesting games to graph plotting and a training aid for elementary multiplication and division. Appendix 4 as mentioned above contains sample answers to the problems set throughout the book. The reader's attention is drawn to the fact that answers involving the writing of programs may vary from that written by the reader as there is often more than one way in which a solution may be obtained. The acid test must be: does it work? In conclusion Appendix 5 comments briefly upon the 16K add-on RAM that is now available for the ZX80.



The ZX80 Pocket Book by Trevor Toms, Published by Phipps Associates
ISBN 0 950 730203, 124 pages £4.95

In chapter 1 — ABOUT THIS BOOK — the reader is told that 'this is not a book for the complete beginner; it is intended for the student, who wishes to develop his or her programming skill, and for the experienced programmers who want a concise summary of the unique characteristics of this machine. If you are a beginner, make sure that you have read in detail the Sinclair BASIC Manual before you start.

The book has seven chapters and five appendices. Chapter 1 is brief: two pages, apart from stating that the book is not intended for the beginner, briefly reviews the history of the ZX80 and very briefly tells the reader what he will find in the following pages.

Chapter 2 — REVIEW OF ZX80 BASIC — seven pages. Is mainly concerned with the importance of writing efficient programs with respect to memory size. It stresses the fact that the ZX80 in its basic form must have programs written for it that are designed for its limited memory but that one must 'never sacrifice clarity and flexibility for size'.

Chapter 3 — PROGRAMMING THE ZX80, nine pages. Opens by stating 'that this book is not intended to teach anyone BASIC. The main function is to show how the statements and commands can be used to their full potential . . .' Mr Toms then proceeds to give the reader an eleven-step procedure for writing a working program. All very clear and concise — I wonder how often many of us jump a step and spend a great deal of time finding out what went wrong! The rest of the chapter has a number of useful hints under such headings as REM, GOSUB, Data Validity, Graphics etc.

Chapter 4 — PROGRAM STORAGE AND RETRIEVAL, three pages. There is little here you do not already know if you have read the Operating Manual. For all that, it makes three pages of common sense that are worth repeating.

Chapter 5 — DATA FILE STORAGE AND RETRIEVAL, three pages. As for Chapter 4 . . . read and inwardly digest!

Chapter 6 — PROGRAM LISTINGS, 43 pages. Twelve programs, mainly games, but also one for Machine Code conversion, another for share evaluation and a section on useful subroutines. The machine code conversion program is backed up by thirteen pages in the appendices containing the Hex and decimal values for the ZX80 instruction set.

Chapter 7 — BASIC COMMAND SET, 37 pages. Gives a very comprehensive review of all the Sinclair ZX80 commands, what they do, examples of their use, together with some useful 'tricks' associated with the individual commands.

The book concludes with appendices, listing in a clear and concise manner the character set, graphic symbols, error codes, a summary of the ZX80 commands in addition to the Hex and decimal values for the ZX80 as mentioned above.

The ZX80 Companion (Second Edition) By Bob Mauder, Terry Trotter and Ian Logan
Published by Linsac, ISBN 0 907211003, 128 pages £7.95

The preface informs the reader that "The ZX80 Companion . . . is intended to be a manual for the broad spectrum of ZX80 owners, for the electronics specialist wishing to learn about microcomputers, to the computer professional buying his own system for the first time, and most particularly to the person wanting to use a computer in his own home."

The Introduction goes further "The Manual is arranged so that an intending user of the ZX80 *entering computing for*

the first time (my italics) may start using the system quickly and then gradually gain a better appreciation of the machine and its facilities".

There is no doubt in my mind whatsoever that this book contains a mine of useful information — but for whom? Certainly it is *not* a book intended for the user entering computing for the first time. It is a book for those that have a good knowledge of computing techniques, an even better book for those who already have a fundamental understanding of how a microprocessor works and wish to use this knowledge to manipulate the operation of the ZX80. In my opinion the outcome of the above is that this book could stand a little rethinking on its layout as there are a few anomalies introduced in an attempt to broaden the contents to suit a larger readership.

If one assumes the alteration of direction ie. a book for the confirmed enthusiast, then one sees a different picture.

Chapter One — OPERATING THE ZX80, most of this chapter is already in the Sinclair Operating Manual, but it is clearly explained, and a second opinion does no harm.

Chapter Two — THEORY OF COMPUTERS, is a short chapter (four pages) and is probably redundant to the computer enthusiast.

Chapter Three — ZX80 BASIC, explains ZX80 BASIC clearly, sensibly giving two streams of information 1) for readers already familiar with another dialect of BASIC and 2) for those to whom BASIC is a new language. Chapter Three ends with an introduction to Machine Code programming on the ZX80. Chapter Four — The ZX80 MONITOR — gives the reader thirty pages of useful routines containing "a series of programes that can be used to examine all parts of the monitor". A knowledge of ZX80 machine language is required for a few of the programs but the listings are explained in detail making this chapter a useful focus for later reference.

Chapter Five — CONSTRUCTION AND HARDWARE, is intended as a compliment to Sinclair's assembly instructions for the ZX80 kit and as such gives a prospective builder a few hints and tips together with the welcome reassurance that "someone walked this way before — and got out alive".

Chapter Six — ZX80 PROGRAMS, consists of seven program listings each with a description, instructions and what to expect when RUNning the program. Games pre-dominate with a Graph Plotter thrown in for good measure.

Appendix 1 is a comparison of ZX80 Instruction codes and ZX80 Character Set. Apendix 2 briefly describes that shy little fellow 'The 8K ROM' launched last September, this item is causing excitement amongst ZX80 enthusiasts not least because very few have, as yet, been sighted!

Hints and Tips for the ZX80
by A D Hewson and J S Hewson
Published by Hewson Consultants
48 pages £3.50

This book clearly explains to the intelligent ZX80 user how to improve his or her programming potential. The preface states that the book is for "the novice and the expert". Although the absolute novice might only gain a little on the first reading, continued reference to its pages (especially to the TIPS scattered throughout) can only benefit the reader.

Section one deals with LOAD and SAVE problems, how to most conveniently and efficiently use the LIST key, how to estimate the amount of memory still available for use and how best to understand and use the logical functions provided by the ZX80. Section two suggests a number of clever ways in which the user may write programs with great emphasis on the most economical use of memory space.

Section three explains to the reader the importance of understanding the display file and thereby manipulate it to advantage.

Section four introduces the concept of Machine Code Subroutines, examples of which are included in Section five.

Section five lists 12 programs that include useful routines such as Line Renumber, Scroll, Print Stack Numbers and a program to demonstrate a moving display. The routines provide a further understanding of the ZX80 but would be of greater benefit to the less experienced if they were accompanied by clear notes on their operation.

ZX80 Programs Vol 1 by Chris Denning,
Published by Sipprint,
82 pages £5.00

The Introduction states that "This book contains 20 programs for the basic 1K Sinclair ZX80 . . . The programs were written for the newer user in mind . . . whilst being very practical and useful, there are no routines that will be beyond the understanding of any ZX80 owner."

Each program listing is written clearly and is supported by program notes that should make the intention and working of the program clear to the reader. The programs are fairly evenly divided between games and fairly useful routines that include Wavelength/Frequency Conversion, Perpetual Calender, Stock List and a simple Number Solving Routine.

Chris Denning has achieved what he set out to do in an easy-to-read and understand little volume that offers a selection of programs that should appeal to the newcomer to the ZX80.

ZX80 BOOK SURVEY

The ZX80 Magic Book
Published by TimeData Ltd.
40 Pages £4.75

The first 28 pages consist of a variety of program listings (18 in all and one variant) ranging from the quite ambitious Othello and Hexpawn on the games side to Hex Peeker (which displays the values of 64 memory locations in Hex) and a simple Graph Plotter for the more academic.

The rest of the book has a selection of observations on topics such as Debugging, Creating a Program, Improving the Picture, a representation of the ZX80 memory map and concluding with a 'do-it-yourself' approach to adding an extra 4K of RAM.

An interesting little booklet but one is left with the impression that the observations were added to the programs to 'make weight'. The programs seem to work and I have no criticisms of the assorted observations.

Making The Most Of Your ZX80
by Tim Hartnell,
Published by Computer Publications
ISBN 0 907442 005,
108 Pages £6.95

This book was reviewed in last month's CT and is aimed at newcomers to computing. It gives the reader a book of programs to key in and use. These are planned in such a manner that the user steadily learns more and more about the operation of the ZX80 as he 'programs' his way through the book.

Summary

From the above it should be fairly clear which book is your choice. For the newcomer to computing 1) **Learning BASIC with your Sinclair ZX80** and 2) **Making the Most of your ZX80** should be looked at first.

Having enjoyed 1) and/or 2) then **The ZX80 Pocket Book** with its excellent chapter on the BASIC command set is well worth adding to your collection, also look at **Hints and Tips for your ZX80**. For the more advanced user, **The ZX80 Companion** will give you a great deal to think about as will **The ZX80 Monitor Listing** published by Linsac at £5.95. This is a 30 page booklet by Ian Logan which clearly presents a fully disassembled listing of the 4K BASIC/Monitor, divided into the specific routines. A useful reference — but not for the novice!

The **ZX80 Magic Book** and **ZX80 Programs Vol 1** both offer a good selection of programs. The latter is probably a slightly better buy for the newcomer with the basic 1K machine but your own preferences in programs will decide your choice.

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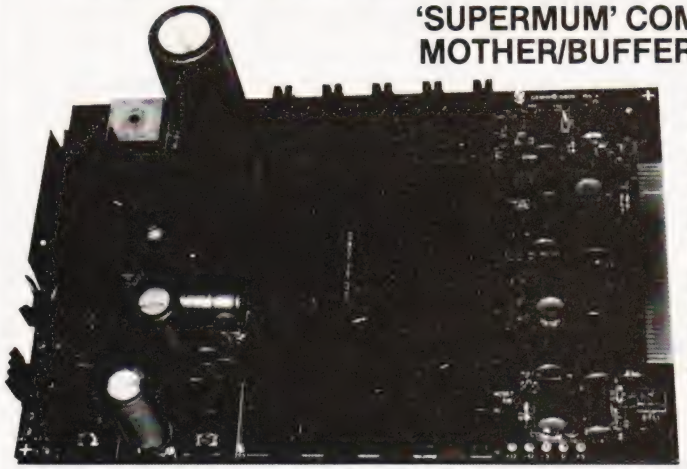

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DRAWING BOARD

Mark R Harrison

Painting by numbers with a ZX80

This simple little program, quite apart from enabling one to draw pretty pictures on the screen of one's ZX80, shows how you can control on-screen movement. You can change the symbol in use and the direction in which you are moving at any time during the program execution.

Instructions And Variables

When the program is RUN an asterisk (star) is displayed on the screen. To alter the symbol in use press '5' then 'NEWLINE' followed by the code of the required symbol and 'NEWLINE'. Changes in the direction of movement can be made by keying the desired direction code, see Fig. 1., and the inevitable 'NEWLINE'.

The program uses the following variables;

D — Position on screen of current symbol.
C — Code of displayed symbol.
A — Direction code.
I — Dummy variable.

Sample Program

Try the following data string, the '/' represents the NEWLINE.
5/128/8/4/2/2/4/4/2/2/2/2/6/6/2/6/8/6/6/6/6/6/6/6/2/6/8/6/6/8/4/8/8/8/8/8/6/8/4/4/4/2/2/2/4/4/4/4/4/8/8/8/5/8/9/9/9/9.

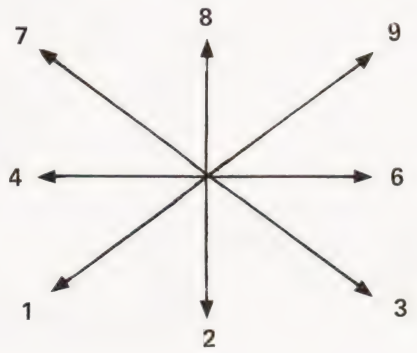

Fig.1. Direction movement and their associated keys

Program Listing

```
10  LET D=310
20  LET C=20
30  FOR I=1 TO 640
40  PRINT" ";
50  NEXT I
60  POKE PEEK(16396)+
    256*PEEK(16397)+D,C
70  INPUT A
80  IF A=1 THEN LET D=D+32
90  IF A=2 THEN LET D=D+33
100 IF A=3 THEN LET D=D+34
110 IF A=4 THEN LET D=D-1
120 IF A=6 THEN LET D=D+1
130 IF A=7 THEN LET D=D-34
140 IF A=8 THEN LET D=D-33
150 IF A=9 THEN LET D=D-32
160 IF A=5 THEN INPUT C
170 GOTO 60
```

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Harold Meerza

Watch your savings grow

This program for the PC1211 computes the interest which is added to your National Savings Bank account at the end of each year. To start the program use SHIFT 'S' in the DEF mode once it is entered.

Program Operation

The balance at the start of the year is input followed by the rate of interest for your account, 5% for ordinary accounts and 15% for investment accounts. For each of the transactions in the account book give the month number, 1 for January etc., or if no transactions were made enter 0. Withdrawals should obviously be preceded by a minus sign.

How It Does It

Line 410 stores the initial balance in the memories A(27) to A(38), one corresponding to each month, and the final balance is kept in A(39). The function SGN in line 460 ensures that a deposit is added only to memories containing later months because interest is not gained in the month of deposit. Similarly withdrawals are debited from the actual month because interest is lost for the whole of that month.

The function INT in line 480 ensures that only whole pounds are totalled for interest, fractions are ignored. The INT in line 490 rounds off the interest to the nearest penny. The program has been checked against a number of accounts and all results agreed with the NSB payments.

Program Listing

```
400 "S":INPUT" BALANCE AT START=";A
405 INPUT" INTEREST%=";H:V=0
410 FOR B=1 TO 13:A(26+B)=A:NEXT B
420 INPUT" MONTH OF FIRST ENTRY=";N:GOTO 440
430 INPUT" MONTH OF NEXT ENTRY=";N
440 IF N=0 GOTO 480
450 INPUT" AMOUNT + OR - =";P
460 FOR B=(N+(SGN(P)+1)/2) TO 13:A(26+B)=A(26+B)+P
470 NEXT B:GOTO 430
480 IF N=0 THEN FOR B=1 TO 12:V=V+INT(A(26+B)):NEXT B
490 I=(H/EXP2)*V/12:I=INT(I*EXP2+.5)/EXP2:Z=A(39)+I
500 BEEP 2:PRINT" INT=";I;" TTL=";Z
```

CONQUERING EVEREST

Scaling the summit requires careful planning, luck and a good head for heights.

This is a computer simulation of an expedition trying to climb Mount Everest, written in Microsoft BASIC for a NASCOM 2. The program is often alarmingly accurate, as climbers in high camps are pinned down by the weather, unable to receive supplies from below.

Basically the idea is a simple one; ropes are laid up the mountain, successively higher camps are occupied and stocked and finally an attempt on the summit is made. The skill lies in the way supplies are moved around and how the Sherpas and Porters are used to the greatest effect.

The expedition consists of 18 climbers, 35 Sherpas (who are used to carrying loads anywhere on the mountain) and 25 porters (who cannot move above Camp 2). There are a total of seven camps on the climb, each of which must be established before moving to the next one. Camp 0 (Base Camp) is the lowest, and at the start of the climb it contains all the people as well as the supplies.

Running The Program

Moving supplies and people about while on the mountain is achieved by defining four types of movement;

1) CARRY — This is where people carry supplies up to another camp, leave their loads there and return to their original camps. This provides a way of moving loads without moving people and is the type of movement Sherpas and Porters are usually used for.

2) MOVE — This is a similar type of movement to CARRY, but here the carrier remains at the camp he carries to. This is used when establishing a new camp, or for moving people around lower down on the mountain.

3) ROUTE — This is the movement used when you are trying to force a route up the mountain. Entering this causes a branch to a separate subroutine, where details of the movement are requested. Between each camp are a number of sections (each one rope-length long), each of which requires one unit of equipment to complete. The number of rope lengths completed is random, but the more people on the route (up to a maximum of four), the more lengths will be laid. The number of sections between each camp is contained in the DATA statement at line 10500, and can be altered to make the climb easy or difficult. Occasionally part of the route may be destroyed by an avalanche and have to be repaired, so it is wise to leave some equipment at Camp 0!

4) SUMMIT — This is a self-explanatory movement, used when you have reached Camp 6, although you must remember that there are two rope lengths above Camp 6 which must be laid before the summit attempt is made. All the climbers in Camp 6 are assumed to take part, but there *must* be at least two. The success of the attempt is dependent on the weather (as are CARRY and MOVE), so you should be prepared to wait at Camp 6 for good weather.

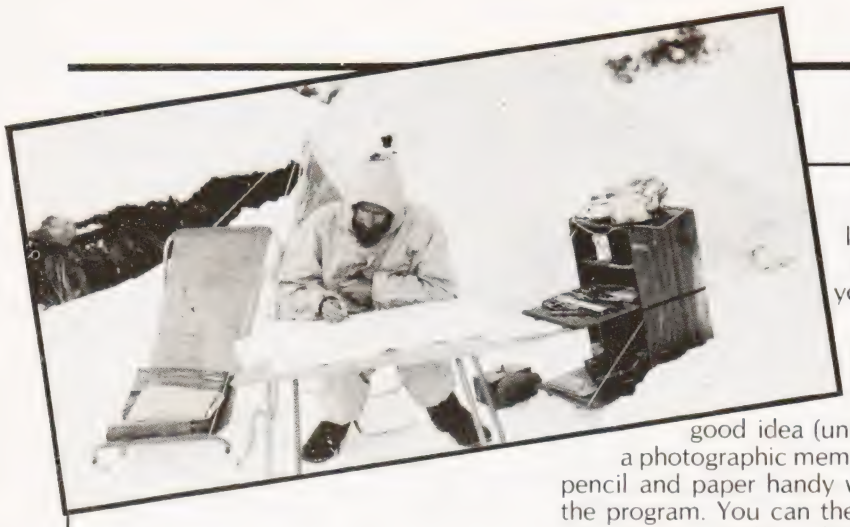
Typing RUN produces the heading 'DAY 1', gives a weather report for the day ahead and asks for a movement input. Since, at this stage, the only way to go is up, ROUTE should be entered. The program then branches to the 'ROUTE' subroutine, where you will be asked to enter the camp you are climbing from and the number of people in the group. The number of rope lengths laid is printed out, and the program branches back to the main body, where you are asked if you want to make another movement that day. Entering NO signals the end of that day, and a series of printouts are produced.

First the day's movements are printed out, those not achieved (the success of a carry depends on the weather, although "carries" made by climbers are always successful) being indicated by '!NC!'. The next is a supply check, which gives a clear indication if any camp is not sufficiently stocked with tents or consumables (in extreme cases the occupants will retreat to the camp underneath them). Finally a comprehensive picture of the situation on the mountain is given, as the contents and occupants of each camp are displayed.

The program then starts a new day, and the process begins again. The number of possible movements increases very rapidly as you progress up the mountain, and to give some idea of how to tackle movements later in the program, I have included a section on tactics.

Tactics

As I have mentioned already, at the beginning of the program there is only one way to go and so there is no need initially to worry about tactics. But as soon as Camp 1 is reached a problem arises — how much should you build it up before moving on? The score you get on reaching the summit depends on the number of days it takes you, so a fast ascent is desirable. On the other hand, if you move up too quickly the top climbers will soon run out of supplies. Another factor is the distance Sherpas and Porters can move in one day, ie two



camps. Obviously the Sherpas and Porters are being used most efficiently when they carry loads up two camps, and so it is sensible to build up alternate camps on the climb. By this argument Camp 1 should not be heavily stocked, although it is a good idea to provide sufficient tents and food for an unexpected descent. After reaching Camp 2 it is a good idea to pause for a day or two to stock up this base before moving on. All the time climbers are above Camp 2 there should be a daily flow of supplies from Camp 0 to Camp 2. Camp 3 is another relatively unimportant camp, although it does become important later on, since Sherpas can carry loads from Camp 3 directly to Camp 5. Camp 4, and those above it, pose a new problem since oxygen is needed. Oxygen can be used up very quickly and it is vital to keep a good supply at Camp 4 for carrying up to higher camps.

At this stage there is a great danger from the 'snowball' effect. This is not a weather feature, but occurs when supplies at a high camp are insufficient, and the climbers have to retreat. They move down to the next camp, and if this camp doesn't have enough supplies the occupants of this camp are forced to retreat as well, and so on right down the mountain. Often this occurs just as two people are ready to make a summit attempt, and they are left stranded while everybody else has been forced down to Camp 2!

If you managed to avoid this trap and are lucky with the weather then you can expect to reach the top in just over a month. It is a very good idea (unless you have a photographic memory) to keep a pencil and paper handy when running the program. You can then use this to note down your planned movements for the next day when all the supplies are printed out at the end of each day.

Modifying The Program

The program loads into just over 8K, but requires about 9K to run in. It can be fitted into an 8K system by removing spaces and REMs.

The BASIC used is a fairly standard Microsoft type (the program was written on a NASCOM 2) which should be easily adapted to other systems. The only command which might cause trouble is 'CLS' (eg line 1000). This simply clears the screen, and a similar command exists in most BASICs (often as a CHR$ function). The subroutine starting at line 2000 POKEs a string onto the top line of the NASCOM VDU, which is unscrolled under NAS-SYS. This is only necessary because of the relatively small size of the NASCOM screen. A simple PRINT statement should be adequate on other machines. The CLEAR 1000 command at line 100 reserves 1000 bytes for use in string manipulation, and can usually be left out. Apart from these few notes the program should run without any other modifications on most systems.

Once you have got used to the program and reached the summit a few times, there are several ways to make a the climb much harder. To reduce the number of successful carries, increase the second numbers in lines 3680-3700. To increase the distance between camps, increase the values in line 10500. the quantity of supplies on the mountain can be altered at line 10030, and the number of people can be changed at line 10040. By doing this you will ensure that the program is always a challenge. Of course, to make the program easier, all you have to do is reverse all the instructions above!

Game Rules

1) At the start of the game all people and supplies are at Camp 0.

2) A maximum of ten movements are allowed per day.

3) At the end of each day all the day's movements are printed out, and those which were not actually carried are marked by "!NC!".

4) Tents hold two people usually, but can hold up to three.

5) One unit of food lasts four man-days.

6) One unit of oxygen lasts one man-day at Camp 6 and two at Camps 4 and 5.

7) The success of a carry depends on the height and the weather, although when the weather is 'perfect conditions' all carries are completed.

8) Before any new camp site is established fixed ropes must be laid to it from the camp below.

9) Only climbers can force the route up the mountain.

10) A maximum of four climbers are allowed to force the route at any one time.

11) Only one attempt per day is allowed on the route above any one camp.

12) All occupied camps must have sufficient supplies for the people in them at all times.

13) Nobody can move more than two camps up or down in any one day.

14) Climbers need oxygen at Camp 4 and above.

15) Sherpas need oxygen at Camp 5 and above.

16) Porters are not able to move above Camp 2.

Program Listing

```
100   CLEAR 1000
200   GOSUB 10000
999   REM ** INPUT
1000  CLS:DD=DD+1
1005  TL$=" DAY "+STR$(DD):GOSUB 2000
1010  NM=0:RF=-1
1015  GOSUB 2200:GOSUB 2300:GOSUB 6000
1020  IF W=-1 THEN 1240
1025  NM=NM+1
1030  IF NM<=10 THEN 1040
1035  PRINT"No more carries":GOTO 1240
1040  PRINT:PRINT"Movement";NM;":":PRINT
1045  PRINT"Input type of movement"
1050  PRINT"1) Carry","2) Move"
1060  PRINT"3) Route","4) Summit"
1065  INPUT IN$
1075  M1=VAL(IN$)
1080  IF M1<1 OR M1>4 THEN 1065
1085  IF M1=3 THEN GOSUB 4000:GOTO 1210
1090  IF M1=4 THEN GOSUB 5000:GOTO 1210
1100  PRINT"Input type of load"
1110  PRINT"1) Equipment","2) Tents",
1115  PRINT"3) Food"
1120  PRINT"4) Oxygen","5) No Load"
1130  INPUT IN$:M2=VAL(IN$)
1135  IF M2<1 OR M2>5 THEN 1130
1140  PRINT"Input carrier",,,"1) Climber"
1150  PRINT"2) Sherpa","3) Porter"
```

```
1160  INPUT IN$:M3=VAL(IN$)
1165  IF M3<1 OR M3>3 THEN 1160
1170  INPUT"Camp of origin";IN$:M4=VAL(IN$)
1175  IF M4<0 OR M4>6 THEN 1170
1178  IF M4=0 AND IN$<>"0" THEN 1170
1180  INPUT"Destination camp";IN$:M5=VAL(IN$)
1185  IF M5<0 OR M5>6 THEN 1180
1188  IF M5=0 AND IN$<>"0" THEN 1180
1190  INPUT"Number of loads";IN$:M6=VAL(IN$)
1195  IF M6<0 THEN 1190
1198  IF M6=0 AND IN$<>"0" THEN 1190
1200  GOSUB 3000
1210  INPUT"Another movement(YES/NO)";RM$
1220  IF RM$="YES" THEN CLS:GOSUB 2000:GOTO 1030
1230  IF RM$<>"NO" THEN 1210
1240  GOSUB 7000:GOSUB 9000:GOSUB 8000
1250  GOSUB 2500:GOTO 1000
1998  REM** UTILITY
1999  REM** Top Line
2000  FOR D=1 TO LEN(TL$)
2010  POKE 3019+D,ASC(MID$(TL$,D,1))
2020  NEXT:RETURN
2099  REM** High Point
2100  D=7
2110  D=D-1:IF TN(D)<>0 THEN HP=D:RETURN
2120  IF D<=0 THEN RETURN
2130  GOTO 2110
2199  REM** Array resets
2200  FOR D=0 TO 6
2210  DC(D)=CL(D):DS(D)=SH(D):NEXT
2220  FOR D=0 TO 2:DP(D)=PT(D):NEXT
2230  FOR D=0 TO 10:M$(D)="":NEXT
2250  RETURN
2299  REM** WEATHER
2300  PRINT"WEATHER :";
2310  W=INT(RND(1)*3+1.4)
2320  ON W GOTO 2340,2380,2400,2420
2340  IF RND(1)>.85 THEN 2360
2350  PRINT"Very bad - snow & wind forecast"
2355  RETURN
2360  PRINT"! STORM ! - No movement today"
2370  INPUT"Press ENTER to continue";Z$
2375  W=-1:RETURN
2380  PRINT"Poor - strong winds forecast"
2390  RETURN
2400  PRINT"Good - only light snow predicted"
2410  RETURN
2420  PRINT"Perfect conditions"
2430  RETURN
2499  REM** DISPLAY
2500  CLS:GOSUB 2000
2510  FOR D=0 TO 6:PRINT TAB(13+5*D);D;:NEXT
2520  PRINT:PRINT:PRINT"Equipment";
2530  FOR D=0 TO 6:PRINT TAB(13+5*D);EQ(D);:NEXT
2540  PRINT:PRINT"Tents";
2550  FOR D=0 TO 6:PRINT TAB(13+5*D);TN(D);:NEXT
2560  PRINT:PRINT"Food";
2570  FOR D=0 TO 6:PRINT TAB(13+5*D);FD(D);:NEXT
2580  PRINT:PRINT"Oxygen";
2590  FOR D=0 TO 6:PRINT TAB(13+5*D);OX(D);:NEXT
2600  PRINT:PRINT:PRINT"Climbers";
2610  FOR D=0 TO 6:PRINT TAB(13+5*D);CL(D);:NEXT
2620  PRINT:PRINT"Sherpas";
2630  FOR D=0 TO 6:PRINT TAB(13+5*D);SH(D);:NEXT
2640  PRINT:PRINT"Porters";
2650  FOR D=0 TO 2:PRINT TAB(13+5*D);PT(D);:NEXT
2700  PRINT:PRINT
2710  PRINT"Now plan your movements for day";
2720  PRINT DD+1:PRINT
2730  INPUT"ENTER when you are ready";Z$
2740  RETURN
2999  REM** MOVE, CARRY
3000  M$(NM)=STR$(M1)+STR$(M2)
3005  M$(NM)=M$(NM)+STR$(M3)+STR$(M4)
3010  M$(NM)=M$(NM)+STR$(M5)+STR$(M6)
3050  ME=0:GOSUB 3500:IF ME=2 THEN RETURN
3055  IF ME=1 THEN NM=NM-1:RETURN
3060  ON M2 GOTO 3070,3080,3090,3100,3120
3070  EQ(M4)=EQ(M4)-M6:EQ(M5)=EQ(M5)+M6
3075  GOTO 3120
3080  TN(M4)=TN(M4)-M6:TN(M5)+M6
3085  GOTO 3120
3090  FD(M4)=FD(M4)-M6:FD(M5)=FD(M5)+M6
3095  GOTO 3120
3100  OX(M4)=OX(M4)-M6:OX(M5)=OX(M5)+M6
3120  IF M1=1 THEN RETURN
3140  ON M3 GOTO 3150,3160,3170
3150  CL(M4)=CL(M4)-M6:CL(M5)=CL(M5)+M6
3155  RETURN
3160  SH(M4)=SH(M4)-M6:SH(M5)=SH(M5)+M6
3165  RETURN
3170  PT(M4)=PT(M4)-M6:PT(M5)=PT(M5)+M6
3175  RETURN
3499  REM** CHECK 1
3500  IF M3<>3 OR M5<=2 THEN 3510
3505  PRINT"Porters too high":ME=1
3510  ON M2 GOTO 3515,3520,3530,3540,3560
3515  IF EQ(M4)-M6>=0 THEN 3560
3518  GOTO 3550
3520  IF TN(M4)-M6>=0 THEN 3560
3523  GOTO 3550
3530  IF FD(M4)-M6>=0 THEN 3560
3533  GOTO 3550
3540  IF OX(M4)-M6>=0 THEN 3560
3550  PRINT"Too few supplies for carry":ME=1
3560  ON M3 GOTO 3570,3580,3590
3570  IF DC(M4)-M6<0 THEN 3600
3575  DC(M4)=DC(M4)-M6:GOTO 3610
3580  IF DS(M4)-M6<0 THEN 3600
3585  DS(M4)=DS(M4)-M6:GOTO 3610
3590  IF DP(M4)-M6<0 THEN 3600
3595  DP(M4)=DP(M4)-M6:GOTO 3610
3600  PRINT"Too few carriers for carry":ME=1
3610  IF M5-M4<=2 then 3620
3615  PRINT"Too much height gain":ME=1
3620  IF M5-M4<>2 THEN 3630
3625  IF RF(M4+1,1)<>RF(M4,0) THEN 3640
3630  IF RF(M4,0)=RF(M4,1) OR M4>M5 THEN 3650
3640  PRINT"Route not established":ME=1
3650  IF ME=1 THEN RETURN
3655  IF W=4 THEN RETURN
3660  IF M3=1 THEN RETURN
3670  WF=RND(1)*(W+RND(1))
3680  IF M5<=2 AND WF>.8 THEN RETURN
3690  IF M5<=4 AND WF>1 THEN RETURN
3700  IF M5<=6 AND WF>1.25 THEN RETURN
3720  M$(NM)=M$(NM)+"NC"
3730  ME=1:RETURN
3999  REM** ROUTE
4000  CLS:GOSUB 2000
4005  M$(NM)=" 3"
4010  PRINT:PRINT"ROUTE FORCING":PRINT
4015  PRINT"Route forcing from which camp";
4020  INPUT IN$:M4=VAL(IN$)
4025  IF M4>6 OR M4<0 THEN 4020
4030  IF M4=0 AND IN$<>"0" THEN 4020
4035  IF RF<>M4 THEN 4045
4040  PRINT"One try per day":RETURN
4045  IF EQ(M4)>0 THEN 4060
4050  PRINT"No equipment available":RETURN
4060  IF RF(M4,0)<>RF(M4,1)THEN 4080
4070  PRINT"Route already completed":RETURN
4080  PRINT:RF=M4
4090  IF RF(M4,1)<>0 THEN 4110
4100  PRINT"You are on a fresh route"
4105  GOTO 4120
4110  PRINT RF(M4,0)-RF(M4,1);"rope";
4115  PRINT" lengths to go to finish route"
```

```
4120  PRINT
4130  INPUT"No. of climbers on route";IN$
4135  M6=VAL(IN$):IF M6<=0 THEN 4130
4140  IF CL(M4)<>0 THEN 4160
4150  PRINT"No climbers available":RETURN
4160  IF CL(M4)-M6>=0 THEN 4180
4170  PRINT"Only";CL(M4);"climbers available"
4175  GOTO 4130
4180  IF M6<=4 THEN 4190
4185  PRINT "Group too large":GOTO 4130
4190  PRINT
4200  RT=INT(RND(1)*M6+1)
4210  IF RT>EQ(M4) THEN RT=EQ(M4)
4220  EQ(M4)=EQ(M4)-RT
4230  RF(M4,1)=RF(M4,1)+RT
4240  IF RF(M4,1)>=RF(M4,0) THEN 4280
4250  PRINT RT;"rope lengths laid. Still";
4260  PRINT RF(M4,0)-RF(M4,1);"lengths to go"
4270  PRINT"Try again tomorrow":RETURN
4280  RF(M4,1)=RF(M4,0)
4290  PRINT"Congratulations"
4300  PRINT"You have completed this section"
4310  RETURN
4999  REM** SUMMIT
5000  CLS:GOSUB 2000
5005  M$(NM)=" 4"
5010  PRINT" SUMMIT BID":PRINT
5020  IF RF(6,1)=2 THEN 5040
5030  PRINT"Top rope sections not laid":RETURN
5040  IF CL(6)>=2 THEN 5100
5050  PRINT"Too few climbers for bid":RETURN
5100  IF RND(1)*W>2.5 THEN 5130
5110  PRINT"Bid unsuccessful -";
5120  PRINT"Try again tomorrow":RETURN
5130  PRINT:SR=SR+CL(6)
5140  PRINT" !!! SUMMIT REACHED !!!"
5150  PRINT:PRINT"Congratulations":PRINT
5160  PRINT"Do you want to make another";
5170  PRINT"attempt";
5180  INPUT"(YES/NO)";D$
5190  IF D$="YES" THEN RETURN
5200  IF D$<>"NO" THEN 5180
5210  S=(SR*1000)/DD:PRINT
5200  PRINT"Your score is";S
5230  END
5999  REM** ACCIDENT
6000  IF RND(1)<.9 THEN RETURN
6010  ON INT(RND(1)*1.4+1) GOTO 6100,6200
6099  REM** ICE FALL
6100  GOSUB 2100:IF HP<1 THEN RETURN
6105  RF(0,1)=RF(0,1)-INT(RND(1)*2+1.5)
6110  PRINT"An avalanche has swept away";
6120  PRINT"part of the route","between";
6130  PRINT"camps 0 & 1."
6140  PRINT"";INT(RND(0)*2+1.5);"lengths";
6150  PRINT"of rope have been lost."
6160  PRINT"This must be repaired before";
6170  PRINT"any loads can","be moved from";
6180  PRINT"Camp 0."
6190  RETURN
6199  REM** AVALANCHE
6200  GOSUB 2100:AC=INT(RND(1)*HP)
6220  PRINT"Camp";AC;"has been hit by an";
6230  PRINT"avalanche !"
6240  PRINT"";INT(RND(1)*2+1.6);
6250  PRINT"tents have been lost."
6260  TN(AC)=TN(AC)-INT(RND(0)*2+1.6)
6270  RETURN
6999  REM** CONSUMABLES
7000  FOR D=0 TO 6
7005  TP=CL(D)+SH(D)
7010  IF D<=2 THEN TP=TP+PT(D)
7020  IF TP=0 THEN NEXT:RETURN
7025  IF D=4 THEN OX(D)=OX(D)-CL(D)/2
7030  IF D=5 THEN OX(D)=OX(D)-TP/2
7040  IF D=6 THEN OX(D)=OX(D)-TP
7050  FD(D)=FD(D)-INT(TP/4+.5)
7060  IF OX(D)<0 THEN OX(D)=0
7070  IF FD(D)<0 THEN FD(D)=0
7080  NEXT
7090  RETURN
7999  REM** CHECK 2
8000  CLS:GOSUB 2000:PRINT
8010  PRINT"Supply Check":PRINT
8015  FOR D=0 TO 6:EV=0
8020  TP=CL(D)+SH(D)
8030  IF D<=2 THEN TP=TP+PT(D)
8040  IF TP=0 THEN NEXT:INPUT D$:RETURN
8050  IF TP<=2*TN(D) THEN 8080
8060  PRINT"Too few tents at camp";D
8070  IF TP>4*TN(D) THEN EV=1
8080  IF TP<4*FD(D) THEN 8110
8090  PRINT"Food is running out at camp";D
8100  IF TP>6*FD(D) THEN EV=1
8110  IF D<4THEN 8150
8120  IF TP<2*OX(D) THEN 8150
8130  PRINT"Oxygen is running out at camp";D
8140  IF TP>3*OX(D) THEN EV=1
8150  IF EV=1 THEN GOSUB 8500:GOTO 8170
8160  PRINT"Everything OK at camp";D
8170  NEXT
8180  INPUT D$:RETURN
8499  REM** RETREAT
8500  PRINT:PRINT"!!! The climbers at camp";D;
8505  PRINT"are retreating!!!":PRINT
8510  CL(D-1)=CL(D-1)+CL(D):CL(D)=0
8520  SH(D-1)=SH(D-1)+SH(D):SH(D)=0
8530  IF D<=2 THEN PT(D-1)=PT(D-1)+PT(D):PT(D)=0
8550  RETURN
8999  REM** PRINT CARRY
9000  CLS:GOSUB 2000
9010  PRINT"The days movements :-":PRINT
9020  FOR D=1 TO NM
9030  PRINT D;":";
9040  ON FNM(2) GOTO 9050,9055,9060,9065
9045  GOTO 9150
9050  PRINT"Carry,";:GOTO 9070
9055  PRINT"Move,";:GOTO 9070
9060  PRINT"Route":GOTO 9150
9065  PRINT"Summit":GOTO 9150
9070  ON FNM(4) GOTO 9075,9080,9085,9090,9095
9075  PRINT"Equipment,";:GOTO 9100
9080  PRINT"Tents,";:GOTO 9100
9085  PRINT"Food,";:GOTO 9100
9090  PRINT"Oxygen,";:GOTO 9100
9095  PRINT"No load,";
9100  ON FNM(6) GOTO 9105,9110,9115
9105  PRINT"Climber,";:GOTO 9120
9110  PRINT"Sherpa,";:GOTO 9120
9115  PRINT"Porter,";
9120  PRINT FNM(8);" - >";FNM(10);",";FNM(12);
9130  IF RIGHT$(M$(D),2)="NC" THEN 9140
9135  PRINT:GOTO 9150
9140  PRINT"! NC !"
9150  NEXT
9155  PRINT:PRINT"Press ENTER to continue";
9160  INPUT Z$:RETURN
9999  REM** INITIAL
10000 DIM EQ(6),TN(6),FD(6),OX(6)
10010 DIM CL(6),SH(6),PT(6)
10015 DIM DC(6),DS(6),DP(6)
10020 DIM RF(6,1),M$(10)
10030 EQ(0)=100:TN(0)=75:FD(0)=900:OX(0)=80
10040 CL(0)=18:SH(0)=34:PT(0)=25
10050 FOR D=0 TO 6:READ RF(D,0):NEXT
10060 DEF FNM(KD)=VAL(MID$(M$(D),KD,2))
10200 RETURN
10500 DATA 6,5,4,3,4,3,2
```

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COMPLEX ROOT SOLVER

D V Mercy

Asking your computer for the root of -1 can cause a hiccup. This gets over the problem

The program described here calculates and lists the roots of polynomials, provided the coefficients are real. The polynomial can be of any order and both real and complex roots are derived.

The program is listed in Microsoft BASIC, as used by the NASCOM 2, but should run under most BASICs with little or no modification. A number of minor changes, which may be necessary for other machines, are discussed later.

Iterative Solutions

An iteration procedure, based on the methods of Lin and Bairstow, is used to extract quadratic factors from the polynominal of interest. This procedure has good convergence characteristics and is nearly always successful, even when the initial trial factor is wildly wrong. In the case of an odd order polynominal there is at least one real root and this is determined last of all.

For readers with a mathematical bent, the background theory of the Lin-Bairstow iteration can be found in the references at the end of the article. Generally speaking, the procedure is to start with a trial quadratic factor and to divide it into the polynomial under investigation. If, by good luck or insight, the quadratic is an exact factor of the polynominal then no remainder is left after the division has been carried through. As is more likely, a remainder does result and the Lin-Bairstow iteration is used repeatedly to optimise the coefficients of the quadratic factor. After each trial division the magnitudes of the remainder are tested and if sufficiently small that cycle of the iteration procedure is terminated. Well known methods are available to obtain the two roots from the quadratic factor so obtained.

If the initial polynominal was of order n, then after the quadratic factor has been extracted, the polynominal that remains is, of course, of order (n-2). The process is repeated to find another factor, and so on, until the final polynominal that is left is simply first order or a quadratic, which is easily solved.

The program gives the user the opportunity to enter trial values of his own before the iteration is started. This may reduce the execution time of the program. Failing this, each new iteration starts with a trial quadratic factor $x^2 + 0x + 0$.

Although, in principle, polynominals of any order can be solved, rounding errors will become important on machines with limited numerical accuracy especially with high order polynominals. Typically, results accurate to five figures will be obtained on a machine with 6/7 figure capability for a polynominal of order ten (and the program will take about 25 seconds).

In common with most other iterative procedures, reduced accuracy is obtained in the final results when two or more roots are identical (multiple roots). For example, on a machine with 6/7 figure accuracy, the answers for a double root may be accurate to only three significant figures.

Program Notes

Finally, some comments about the program listing.

1. CLS is the "clear screen" instruction. Insert your own routine if different. All such lines can be deleted if preferred.
2. If your BASIC does not support variables in DIM statements then insert a numerical value in line 80 that exceeds by two the highest order polynomial you are likely to investigate. Of course, if your BASIC has no restrictions on the number of subscripted variables then line 80 can be deleted.
3. If your BASIC does not use ASCII codes and the CHR$ function for screen editing then use your own routines. (19 is move cursor up; 27 is delete line and put cursor to start. In Hex these are 13H and 1BH respectively.) If necessary all such lines can be deleted, as can 530. If this is done remember to increase by one the addresses given in lines 190, 430, 470 and 640.
4. With a BASIC that has more than 6/7 figure accuracy you can reduce the test value, K, in line 420, as appropriate, to give more accurate answers but with increased execution times.
5. Multiple statements are used with the IF-THEN routine in several places. If your interpreter does not like these it is not difficult to re-write them.

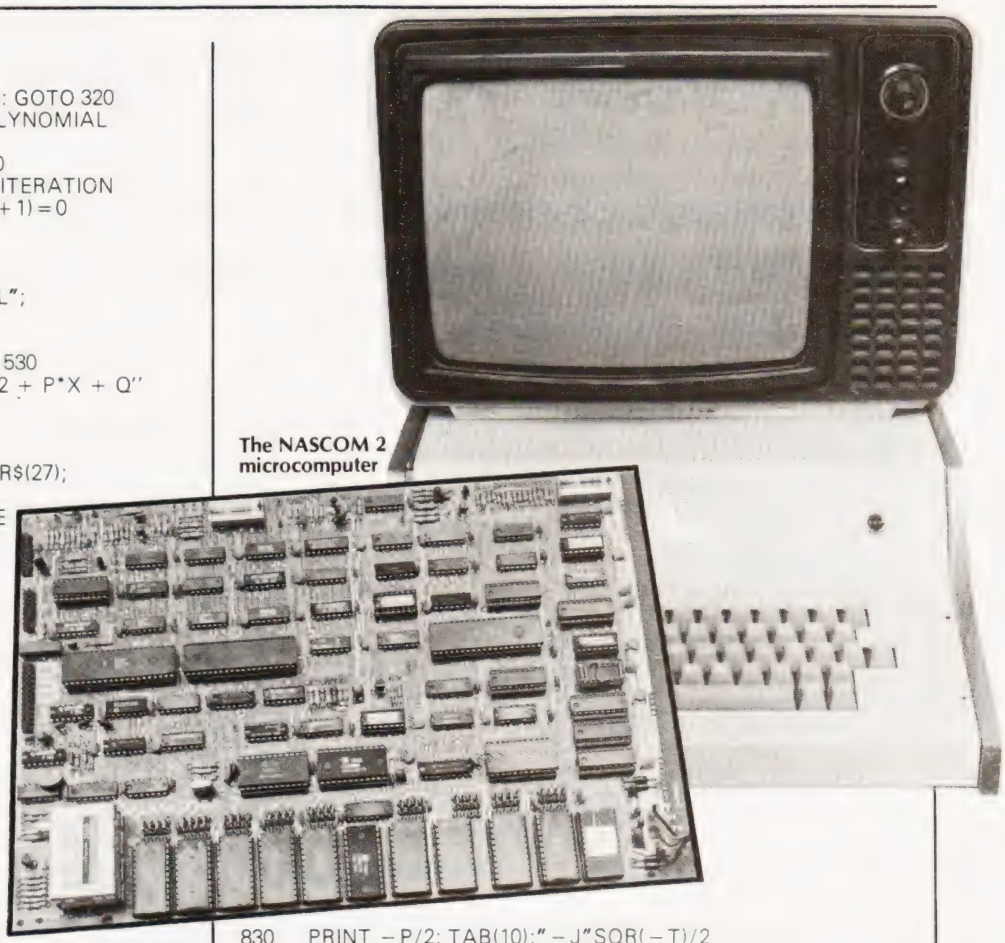
References

1. HAMMING W. "Numerical Methods", Mc Graw Hill 1962
2. MUELLER J.L. "Arithmetic Techniques", Electronic Design, Sept. 12, 1968
3. LEE, BEECH & LEE "Computer Programs", Sigma Press, 1978.

Program Listing

```
10    REM**ROOTS OF POLYNOMINALS
20    REM**ROOTS OF A(N).X↑N + A(N-1).X↑(N-1) + .. + A(0)
30    CLS
40    REM**INPUT DATA
50    INPUT "ENTER ORDER OF POLYNOMIAL";N
60    IF ABS(INT(N)) = N THEN 80
70    PRINT "INVALID ENTRY": GOTO 50
80    DIM A(N+2),B(N+2),C(N+2)
90    FOR M = N TO 0 STEP -1
100   PRINT "ENTER A("M")";
110   INPUT A(M)
120   NEXT M
130   INPUT "ARE ALL ENTRIES CORRECT"; K$
140   PRINT CHR$(19); CHR$(27);
150   IF LEFT$(K$,1) = "Y" THEN 240
160   IF LEFT$(K$,1) < > "N" THEN 130
170   INPUT "ENTER ORDER OF INCORRECT COEFF."; L
180   IF L > N THEN 200
190   IF ABS(INT(L)) = L THEN 210
200   PRINT "INVALID ENTRY": GOTO 170
210   PRINT CHR$(19); CHR$(27);
220   PRINT "ENTER NEW VALUE OF A("L")";
230   INPUT A(L): GOTO 130
240   IF N = 0 THEN PRINT "TRIVIAL PROBLEM": GOTO 990
250   IF A(N) = 0 THEN N = (N - 1): GOTO 240
260   FOR M = (N - 1) TO 0 STEP -1
270   A(M) = A(M)/A(N): NEXT M: A(N) = 1: H = 0
280   CLS
290   PRINT "A LIST OF THE ROOTS WILL FOLLOW"
300   FOR W = 1 TO 1000: NEXT W
310   CLS
320   REM**TEST FOR ROOTS AT THE ORIGIN
```

```
330   IF A(0)<>0 THEN 360
340   PRINT "0": N=N-1: IF N=0 THEN 990
350   FOR M=0 TO N: A(M)=A(M+1): NEXT M: GOTO 320
360   REM**TEST FOR 1ST OR 2ND ORDER POLYNOMIAL
370   IF N=1 THEN PRINT -A(0): GOTO 990
380   IF N=2 THEN P=A(1): Q=A(0): GOTO 750
390   REM**SET UP INITIAL CONDITIONS FOR ITERATION
400   A(N+2)=0: A(N+1)=0: B(N+2)=0: B(N+1)=0
410   C(N+2)=0: C(N+1)=0
420   P=0: Q=0: R=0: S=0: K=N*1E07
430   IF H=1 THEN 530
440   PRINT "DO YOU WISH TO ENTER A TRIAL";
450   INPUT "FACTOR"; H$
460   PRINT CHR$(19); CHR$(27);
470   IF LEFT$(H$,1)<>"Y" THEN H=1: GOTO 530
480   PRINT "FACTORS ARE OF THE FORM X↑2 + P*X + Q"
490   INPUT "ENTER THE VALUE OF P"; P
500   PRINT CHR$(19); CHR$(27);
510   INPUT "ENTER VALUE OF Q"; Q
520   PRINT CHR$(19); CHR$(27); CHR$(19); CHR$(27);
530   PRINT TAB(10); "WAIT!"
540   REM**SYNTHETIC DIVISION PROCEDURE
550   P=P+R: Q=Q+S
560   FOR M=N TO 1 STEP -1
570   B(M)= A(M)-Q*B(M+2)-P*B(M+1)
580   C(M)= B(M)-Q*C(M+2)-P*C(M+1)
590   NEXT M
600   B(0)= A(0)-Q*B(2)
610   REM**TEST REMAINDERS
620   IF ABS(B(0)/A(0))>K THEN 650
630   IF ABS(B(1)/A(1))>K THEN 650
640   GOTO 730
650   REM**UPDATE OF P AND Q
660   D=C(1)-B(1)+P*C(2)
670   E=C(2)+P*C(3)
680   F=D*C(3)-E*C(2)
690   IF F=0 THEN 970
700   R=(B(0)*C(3)-E*B(1))/F
710   S=(D*B(1)-B(0)*C(2))/F
720   GOTO 550
730   PRINT CHR$(19); CHR$(27);
740   REM**SOLUTION OF QUADRATIC FACTOR
750   T=P*P-4*Q
760   T<=0 THEN 800
770   IF P<0 THEN Z=-P/2+SQR(T)/2: GOTO 790
780   Z=-P/2-SQR(T)/2
790   PRINT Z: PRINT Q/Z: GOTO 840
800   IF T<0 THEN 820
810   PRINT -P/2; PRINT -P/2; GOTO 840
820   PRINT -P/2; TAB(10);"+J"SQR(-T)/2
830   PRINT -P/2; TAB(10);"-J"SQR(-T)/2
840   REM**PRELIMINARIES BEFORE LOOPING BACK
850   IF N<3 THEN 990
860   N=N-2
870   FOR M=N TO 0 STEP -1
880   A(M)=B(M+2): NEXT M
890   GOTO 370
970   PRINT "DETERMINANT=0"
980   PRINT"PROGRAM HALTED"
990   END
```



The NASCOM 2 microcomputer

RECORD HANDLER MODS

David A Cameron

Improvements to our general purpose records program

The following alterations will provide an additional facility within the General Purpose Records program by A P Stephenson that was published in August '80. The facility is to allow the addition of information to a file rather than the simple modification of it. These changes were developed on an 8K PET, the length of the program was reduced by over 500 bytes by removing all the REMs and using the following subroutine;

```
4000  PRINT " [↑ % ] [33 SPC ] [↑ ' ]":
      RETURN
```

which replaces lines 140,160,180,200, 220,240,260 and 274 provided a GOSUB 4000 is included on all the previous lines.

Program Listing

```
105   A=1
274   PRINT " [↑ % ] [38 SPC ] [↑ ' ]"
275   PRINT " [↑ % ] ADD TO A FILE  [21 SPC ]9 [↑ ' ]"
320   IF VAL(K$)<1 OR VAL(K$)>9 THEN PRINT
      E$:PRINT:PRINT:PRINT:GOTO 290
330   ON VAL(K$) GOTO 340,680,980,1780,1830,2180,
      1250,1500,3000
560   FOR R=A TO Y
665   A=1
3000  PRINT "HOW MANY EXTRA RECORDS";TAB (25);:GOSUB
      2380
3005  QQ=VAL(A$(R,C)):IF QQ=0 THEN 110
3010  Y=Y+QQ:IF Y> [maximum number of records ] THEN
      Y=Y-QQ:PRINT " [REV ] TOO MANY":GOTO 3000
3020  A=Y+1:GOTO 560
```

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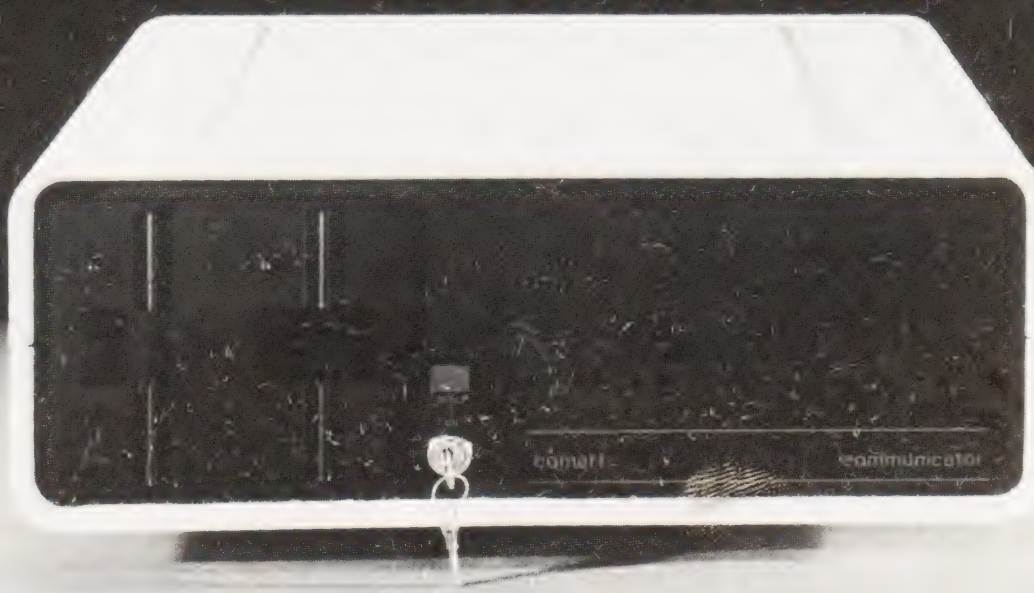

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The PIC-CHIP.... a powerful easy-to-use graphics facility for all New Rom PETs.

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Originally designed for **scientific** and **technical** applications, the PicChip is also being used in **educational projects, games** and **design work** of all kinds. The combination of fast plotting and area manipulation makes the PicChip ideal for the continuous display of real-time data in graphical form.

Just see how easy it is to use PicChip commands: the following examples were all photographed directly from a PET screen.

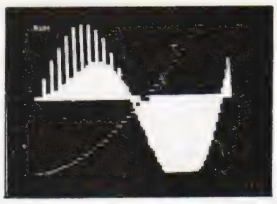
Picture 1 shows two curves, one drawn in fine-density and one in bar form, produced by two program lines:

```
10 FOR X=0 TO 39:Y = X↑1.5:!WF:
NEXT
20 Y0=25:FOR X=0TO79 STEP 3:
Y=SIN(X/12)✱24:!WY:NEXT
```

(1)

Picture 2 adds a third program line to plot a function as adjacent bars:

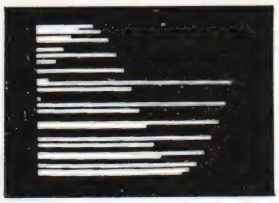
```
30 FOR X = 0 TO 79:Y=SIN(X/12)✱
X/2:!WY:NEXT
```



(2)

If we just take the second program line and change !WY to !WX, the bars are plotted horizontally:

```
20 FOR X = 0 TO 79:Y=SIN(X/12)✱24:
!WX:NEXT
```

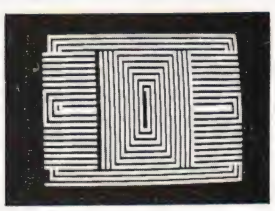


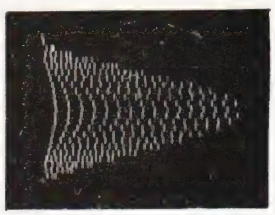
(3)

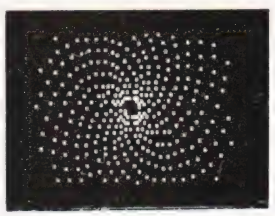
All the other pictures reproduced here were generated by the DEMONSTRATION PROGRAM included in the 20-page Handbook. What we can't show here are the amazing effects produced by shifting or rolling or otherwise manipulating different areas of the screen. There is even a repeat-key function, and commands for reading and setting the cursor position in X,Y co-ordinates.

PicChip Functions.

Command	Function
SYS 45056	PicChip On
!RE	Restore screen
!CO	PicChip off
!RP	Repeat-Key on
!RO	Repeat-Key off
!CW	Cursor-position Write
!CR	Cursor-position Read
!AF	Area Fill
!AR	Area Reverse
!AN	Area Normal
!AI	Area Invert
!AS	Area in Shift case
!AU	Area in Unshift case
!AC	Area Case invert
!AF	Screen Fill
!SR	Screen Reverse
!SN	Screen Normal
!SI	Screen Invert
!SS	Screen in Shift case
!SU	Screen in Unshift case
!SC	Screen Case invert
!US	Up Shift
!DS	Down Shift
!LS	Left Shift
!RS	Right Shift
!UR	Up Roll
!DR	Down Roll
!LR	Left Roll
!RR	Right Roll
!WP	Write Point
!EP	Erase Point
!WL	Write Line
!EL	Erase Line
!WC	Write Continuous line
!EC	Erase Continuous line
!WX	Write bar in X axis
!EX	Erase bar in X axis
!WY	Write bar in Y axis
!EY	Erase bar in Y axis
!WF	Write fine Y
!EF	Erase fine Y
!FW	Write fine X
!FE	Erase fine X
!CS	Copy Screen
!PC	Poke Character







The standard PicChip plugs into socket UD4 of the PET, but is also available to fit either of the other two sockets. PicChip is therefore **compatible with other PET ROM packages.** Installation and use are fully described in the handbook.

The PicChip costs £45 + VAT. To buy the handbook separately costs £5 but this may be offset against an eventual purchase of the chip. State required socket when ordering. **10% discount to educational institutions.**

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John Wellsman

COLOURING THE GENIE

Oriental competition is building up in the small systems market, this latest version of the Video Genie is offering colour graphics. How much of a threat is it? Read on and find out.

At the beginning of last year Video Genies arrived in this country and, although very similar in general function to the TRS-80, they did have some small but significant differences which prevented complete compatibility. These differences were mainly the absence of a 'Right Arrow' and a CLEAR key. The manual supplied with the Genie claimed that these were unimportant and not very often used but apparently it was to prove otherwise.

The Video Genie is now available in a form which makes it almost completely parallel in all functions to the TRS-80 Model I. The version which I tested, the Video Genie EG 3003 now has the CLEAR key and the 'Right Arrow', which were not available on the first model; the two keys occupy the position of the right "SHIFT" key, which is now eliminated. Apart from at least one problem, which I will refer to later, this now means that any program written for the TRS-80 Model I will now run on the Genie.

As the Genie has so entirely modelled itself on the TRS-80, it is almost impossible to avoid comparison with the latter and I do not intend to avoid the temptation to do so! Many who now own a Genie or will buy a Genie in the future don't know Tandy and I appreciate that such comparisons will have little significance but, to others who know both systems, I think the comparison will at least be interesting, if not useful.

The Basic Boxes

The Genie Keyboard/CPU has a cream coloured metal housing with black facings around the keyboard and with imitation wood trimming at each end. Even allowing for the fact that it incorporates a tape recorder, it is appreciably wider than the TRS-80 keyboard. It measures 14.5 inches by 21.5 inches across compared with the TRS-80's eight inches by 16.5 inches across and about 4.75 inches high compared with about 3.75 inches. The keys are almost identical to Tandy's: tough, white with black characters; in action they have rather a metallic (all right, tinny) sound.

To match up completely, the Genie now has an Expander, containing a disc controller for the usual four disc drives, a Centronics compatible edge connector and a female connector for an RS232, though I believe that the actual circuitry is an optional extra. As with the TRS-80, the Keyboard/CPU holds 16K of memory and the Expander can hold up to 32K. The Keyboard and Expander (to the Tandyman an Expansion Interface) are linked by a ribbon connector but for some reason (lack of planning?) the edge connectors are not opposite each other so, when connected, the Expander is offset three or four inches to one side. Apart from taking up more room and making the designers look a little unprofessional, it does not really matter.

A VDU with either a grey or a green nine inch screen is also available which can be placed on the Expander. Its trim is obviously made to match the Genie, though I believe that it is quite a separate item and sold apart from the Genie. There is a good clear image though the lines were a trifle concave at the top and the characters seemed rather small after using my 12 inch screen. One very good point, the vertical and horizontal hold controls were at the *front*. How often have you tried to adjust the controls at the back while trying to judge the effect at the front? (Try using a mirror! Ed.)

As with the earlier model a tape recorder is integrated into the keyboard, a manual control with a calibrated display is now included. There is no calibration on the control knob itself which, to me, shows a surprising absence of knowledge in the use of tape recorders for computers. To be fair, Tandy's tape recorder is only marginally better for their control, also in black plastic, bears numerals in low relief which are almost invisible. When recording or playing back computer programs pre-set levels are vital — one cannot adjust during play. It is impossible to check whether the control has been accidentally moved and one may attempt to LOAD or SAVE without realising this. Therefore, the volume control wheel *must* be calibrated for computer work. Like most sufferers of this ommission, I have roughly calibrated the control wheel of my Tandy recorder myself but this should not be necessary. In so many cases, and this is one, I am certain that although technical men designed the microprocessor, the PCBs and other marvels, they then left it to a job lot of second hand mechanics to finish off.

The volume level display is calibrated but at least in the case of the Genie, this is not all that necessary. Having found the correct playing level, I tried several tapes, some made for Genie and some for Tandy. The deflection of the needle on the dial varied quite considerably but all LOADed first time. However, the display dial is useful in indicating when transfers are taking place; by keeping records of the level at which individual tapes operate, it would also be possible to detect a bad LOAD without wasting too much time. In fact, I did not

have a single bad LOAD and only one bad SAVE, which may have been my fault.

Snags With The System

But to modify this praise, I found a quite serious flaw in the tape system. Having made a LOAD, the computer stops the recorder with the "PLAY" key still depressed. To release this, the "STOP" button is pressed and this nearly always caused the whole system to hang up. The first, obvious, solution was to carry on with the program and leave the recorder as the computer left it but if it was necessary to record data from the program, then the "STOP" button had to be pressed so that the program tape could be removed and a data tape inserted. I found, however, that by very gently and delicately pressing the "STOP" button and preventing it from snapping back, "PLAY" could be released without crashing the program. This may, of course, have been a flaw on the review machine. The movement of tape under the "PLAY" and "RECORD" functions are under the control of the computer but to operate the fast forward and rewind functions, one has to press a little button above the keyboard, marked for some reason (a job lot?) "F1". At the rear of the keyboard, there is a socket for linking a second recorder into the system, thus enabling data to be read in from one unit, processed and written out to the other; a procedure used, I should imagine, only by the extremely keen — and patient — but financially limited amateur. Just by way of an aside, what is the use of a "PAUSE" button on a computer tape recorder?

BASIC Revelations

The BASIC used by the Genie is almost identical to that used by Tandy. There are a few minor differences, and one of the few which might make a difference, though not an incompatibility, is the use of double size characters. These can only be accessed in the Genie

The Genie keyboard unit. The PAGE and F1 buttons referred to in the text are located top right.

by a hardware switch situated behind the keyboard and marked "VIDEO CUT". If this is pressed when the display is in the normal mode, the display is bisected vertically with one half disappearing and the other half remaining visible with double size characters. Above the keyboard, to the left of the button marked "F1", is another button marked "PAGE" and pressing this button will show the right half of the normal display, releasing shows the left half. This can be a bit disconcerting if one leaves the system so that only the right half if visible. When one switches on again, the screen is blank whatever one does (the READY cue, of course, only appears on the left) and when it happended to me, it was only after much weeping and gnashing of teeth that I realised what was happening.

The software method of invoking double size characters with the TRS-80 is to "PRINT CHR$(23)" but if this is used with Genie the result is normal sized characters but with double spacing. A pity that Genie cannot do this, as double size letters suddenly produced in a program are very effective as warnings or checks.

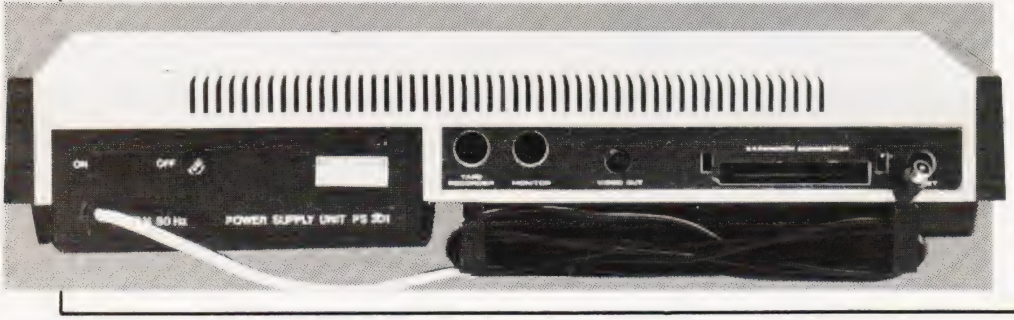
Another small, but less important, difference is that the Genie displays a square bracket instead of an up-arrow when that key is pressed; not uncommon with some printers but not usually seen on the screen. To "AIR RAID" addicts, anti-aircraft shells do not look quite so lethal when shown as square brackets.

Expanding Upwards

When the Expander is added, printers, disc drives and other embellishments can be attached to the system. The edge connectors for printer and disc drives are placed on either side of the connector to the keyboard. Rather a pity, as the modular design of the Genie system entails a rather untidy display of cables and it would be better if as many as possible were kept out of the way. No problems with connecting and using my Centronics printer or with linking up the disc drives. But the main power switch and reset (boot) button seem to be weak points. As with the TRS-80, when the Expander is connected and disc drives are not being used, it is necessary to hold down the "BREAK" button when switching on to stop the system trying to operate non-existent disc drives. However, the ON/OFF switch had to be operated several times before the "READY" appeared. When the drives were connected, the reset button had to be operated more than once to get the discs to boot. In fact, this reset button seemed to be very poorly fitted as the slightest touch would crash the system though not always causing a re-boot. The button itself projects about half an inch from the housing at the rear which may be a cause of its "sensitivity".

So far as I can judge, all Tandy compatible Disc Operating Systems should operate with Genie. Certainly, TRSDOS, NEWDOS + and NEWDOS 80 work perfectly with my limited use of these on the Genie. What I did not have

The rear of our review Genie. Sockets featured are an extra tape outlet, a monitor connection, the VIDEO CUT switch, the expansion connection and, far right, the wobbly RESET. The coiled lead is the normal TV connection.



time to do was to test the Expander with the 80 track drives. It may be necessary to slot in a data separator, if one is not already there.

Colouring Schemes

One of the main reasons for this Model being under review is that it is a colour version. I presumed that it was intended to be used with a domestic colour television and proceeded accordingly. However, there were no instructions or guidance available as to the method of doing this. As, presumably, many other prospective purchasers of colour computers will be in a similar state of ignorance and innocence, this was not exactly a bad thing!

Attached to the Genie is a lead which connects with any ordinary television set (including colour), which makes unnecessary the purchase of a special monitor. It has been my experience, however, that no domestic black and white television set can compete with a monitor for clarity and definition. My experience is not vast in this area and there may be some television sets, when used with some modulators, that give as good an image as a monitor but I have yet to see them. Colour television sets seem to offer the same difficulties, further complicated by the colour dimension. It is fair to assume that most (though perhaps not every one) knows that the connection is made to the aerial input. I suppose that it is also assumed that the retailer will tell the purchaser which spare channel should be used and also that the computer image must be tuned in and how this should be done. My own colour TV is a Philips and Philips do not believe in allowing ready access to the tuning. Perhaps because of this I had great difficulty in getting a satisfactory image. The only stable image that I could get was a monochrome one and at first I imagined that I, or somebody, had blundered. But perseverance did finally produce a colour image of a sort but, to cut a long story short, I was never able to get a colour image worth paying extra for. Again thinking that I or even the TV set was at fault, though it was perfectly satisfactory for ordinary viewing, I inflicted myself and the computer on a friend and neighbour and with their set I was able to get a better image. This TV had horizontal and vertical holds available to the user (at the *back* of the set!) which helped considerably — Philips sets do not have these controls. However, the tuning was so delicate that I was never quite sure that I had the correct colour balance. Another friend was imposed upon and with their set I was able to get an image worth paying for. Lowe's who market the Genie in this country, were kind enough to lend me a dedicated colour monitor and the image on this was superb.

But my experience does indicate that a first-class colour image cannot be guaranteed with an ordinary domestic colour television. Some sets may give a satisfactory display but few can afford to buy a set simply to suit their computer. Only a purpose built colour monitor can be expected to give perfect results.

With the colour hardware installed, the Genie text characters are green and the graphics are shown as red. Games using graphics will give striking contrasts and it matters not whether they were written for the Genie or the TRS-80. One small disadvantage is that when programs using graphics are used with a monochrome display, the graphics are noticeably dimmer or flatter in contrast than the text characters.

A full colour facility is produced by loading a very short colour driver which introduces and extra command "CSET (X,Y,C)" producing a result similar to "SET/X,Y)". The "X" and "Y" position the pixels and "C" sets the colour. However, with this command, there are only 64 pixels across the screen and 32 pixels down, a considerably smaller resolution than with monochrome. The "C" variable can be 0-7 giving eight hues, two of which are black and white, three are primary colours; red, green and blue and the remaining three being secondary colours; cyan (blue-green), yellow and magenta (purple) — quite enough to provide some striking results though a little limited for a Turner sunset.

An instructional and information program with demonstrations was provided but I do hope that the authors look at this again before issuing it for public consumption — it was full of text errors.

Compatability Conclusions

I referred earlier to the compatability of TRS-80 programs to the Genie but, with the colour hardware installed, there is a snag concerning the use of lower case letters in programs which contain them. If the TRS-80 encounters lower case characters in a program, and no lower-case chip is fitted, it automatically converts these to upper-case. It seems, however, that the colour hardware of the Genie uses a part of the memory which performs this conversion and if the colour Genie finds lower-case characters it cannot convert them and displays the ASCII equivalent, whatever that happens to be. The result is garbage — or a "coded garbage", for it can be translated. Thus, the "ADVENTURE" series is, for practical purposes, unreadable as it is written in upper and lower case. Another program which gives difficulties is "VisiCalc", though here the difficulty is much less severe and it would still be possible to use the program. I must emphasise that this "lower-case" problem only applies to the colour version and, so far as I know, there is no difficulty with the monochrome version.

I understand from Lowe's that in a few month's time a new version of the Genie will appear. The cassette will no longer be integrated into the keyboard/CPU and a numeric keypad will be fitted in its place. Also, the righthand "SHIFT" key will be restored and the right and left arrows will be above the "NEW LINE" key.

In spite of the various problems that I encountered (mostly mechanical and curable), there is no doubt that Genie in its present form is capable of most tasks suitable for the micro. With the Expander, the two disc drives lent to me and my own printer I carried out much of the work which I do in my business without any trouble. The only doubts which I have concern the colour display but I believe that this problem is by no means confined to the Genie. What gave me the greatest joy was the simple pleasure of never having a bad CLOAD. My TRS-80 experience has been horrific.

The expander and monitor units. Sockets are, left to right, disc, computer and Centronics printer.

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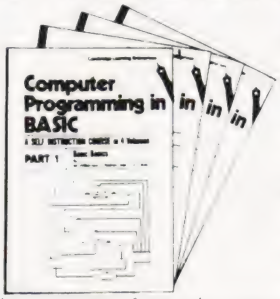

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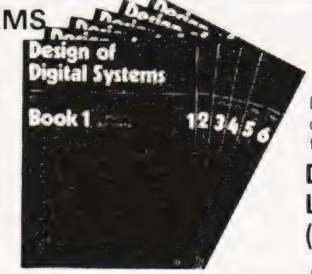

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The program follows what has become the normal structure for Adventure programs. Like the original main frame Adventure, directions can be designated by just the first letter of the compass point and commands may be optionally entered with just the first three letters of the appropriate word. As usual provision is made for saving the game at any stage and such standard commands as Help, Inventory, Score and Quit are all available. Experienced adventurers will inevitably draw comparisons between this series and that of Scott Adams, so we will leave it to them to make their judgements! The only comment that we will make at this time is that we find it quite invigorating to play an Adventure game by a different author as obviously they construct their stories slightly differently. Mysterious Adventure 1, "The Golden Baton" is available on cassette for TRS-80 or Video Genie machines of 16K or more and on disk for 32K up machines. It occupies a full 16K. The tape versions save their game to tape and the disk to disk.

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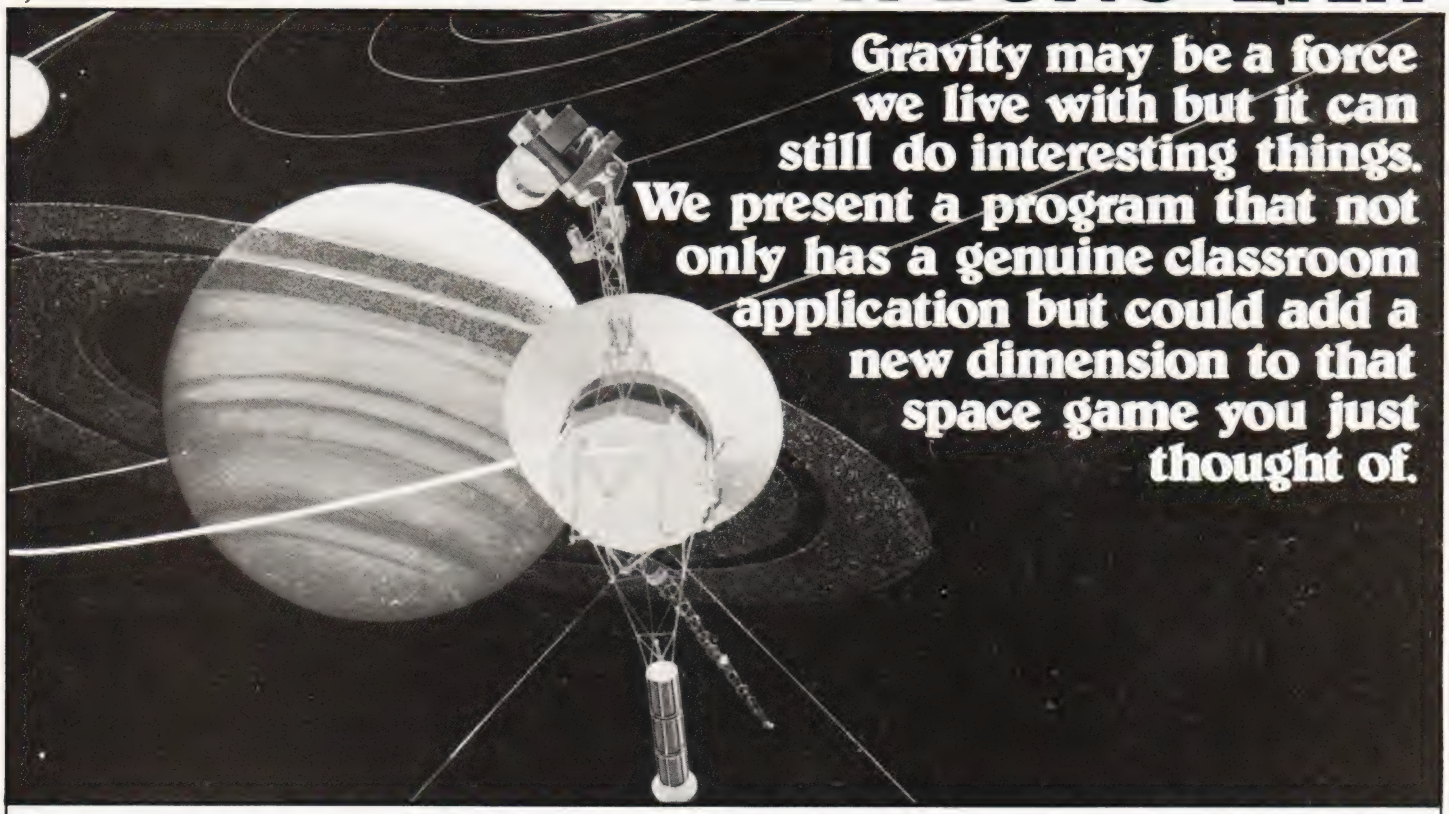


Gravity may be a force we live with but it can still do interesting things. We present a program that not only has a genuine classroom application but could add a new dimension to that space game you just thought of.

A program is described here which allows the user to get a feel for Newton's Law of Gravitation applied to the motion of planets. The orbits of planets are calculated and displayed on a normal cursor addressable VDU and special graphics terminals are not required. By experimentation the user can find stable orbits (circles or ellipses), and the precision of elliptical orbits may be observed. It is also possible to simulate a "slingshot" such as was used to send the Voyager spacecraft from Jupiter to Saturn. In this the spacecraft is aimed in front of the planet, loops round the planet because of its gravity, and finally leaves the planet moving faster than before the encounter. By this devious route the spacecraft gets to Saturn quicker than by going directly — an ingenious way of saving time and fuel! The program itself is written in an elementary subset of BASIC which should be easily implemented on most microcomputers but attention is drawn to the fact that a cursor addressable VDU is required.

Background

Tycho Brahe was one of the earliest astronomers to make accurate observations and measurements of the positions of the planets. Using his data, Kepler deduced three laws of planetary motion:

1. Planets move in ellipses, with the sun at one focus.
2. The radius vector joining the planet to the sun sweeps out equal areas in equal time.
3. The period of orbit squared is directly proportional to the semi-major axis cubed.

Robert Hooke who had been studying the effects of gravity suggested that gravity might vary with the inverse square of distance. Newton checked Hooke's ideas and concluded that an inverse square law for gravity would result in elliptical planetary orbits. Newton's name is remembered since he was the first to publish the result which is generally known as Newton's Law of Gravitation:

$$F = \frac{G*M_1*M_2}{d^2}$$

where F is the force of attraction between two bodies (planet and sun), M_1 and M_2 are the masses of the two bodies, d is the distance between the bodies, and G is the universal gravitational constant. The value of G depends on the system of units used, and with SI units

$$G = (6.673 \pm 0.003) \times 10^{-17}$$
Newton metres^2/kilogram^2

The program uses the equation for Newton's Law of Gravitation together with Newton's second Law of Motion which states that:

force acting on a body = mass of body * acceleration of body

or:

$$F = M * a$$

Very accurate measurements of the orbit of the planet Mercury show that it precesses slightly faster than can be explained using Newton's Laws, and this is explained by Einstein's theory of Relativity. These changes are extremely small, and are ignored in the program.

How To Use The Program

The program first prints a heading (lines 30-40) and then asks if full instructions are required (lines 60-80). The answer must be either YES or NO, this is checked (lines 90-120), and the instructions (lines 130-250) are printed if required. Next the user is asked if he wishes to study the motion of two cosmic bodies, or three, and the reply is checked to ensure that it is either 2 or 3 (lines 270-320).

For simplicity the first two bodies are always placed in motion around each other, and it is only necessary to specify the ratio of the masses of the two bodies and the distance between them. These are input in lines 330-420. The program then calculates the position and velocity of each of the two bodies so that they orbit in the centre of the screen. The program adjusts the value of the gravitational constant G so that the bodies move at a sensible rate on the screen (lines 430-520). The position and velocity of each of these two bodies is printed to assist the user in choosing sensible values for the position and velocity of the third body if three bodies were specified earlier (lines 530-590).

If a third body is being considered, then its position (x,y) and the x,y components of its velocity are requested together with the mass (lines 610-690). Care must be taken when choosing these values or the third body will shoot off the screen in a desperate attempt to reach infinity! When the computer calculated the position and velocity of the first two bodies it did so in such a way that their centre of mass was stationary and at the centre of the screen. This ensured that the bodies stayed on the screen. The addition of a third body not only moves the centre of mass, but also sets it moving so that the picture could drift off the screen. To prevent this the program adjusts all of the velocities (lines 700-760) to make the centre of mass stationary.

During the simulation, the program calculates the positions of the bodies at regular intervals, and displays them in real time on the screen. Two different display modes are available:

1. The path traced by each of the bodies (1, 2 and perhaps 3) are displayed. This allows the route traversed by the bodies to be studied, but the screen may gradually become so filled that it may become confusing.
2. Only the current position of the bodies are displayed, and as new positions are calculated the old ones are erased.

The user makes the choice between these two modes in lines 770-820.

The screen is cleared and variables set (lines 830-1020). In the loop (lines 1050-1120) the bodies are placed on the screen by scaling and rounding the position x,y to produce a character cell P1, Q1 on the screen. The screen is assumed to display 24 lines of 80 characters. The velocity of each of the bodies is recalculated taking account of the gravitational attraction due to the other bodies over a small time interval (lines 1130-1290). The equations used are derived from Newton's Law of Gravitation expressed in x,y component form. The bodies are then moved a distance proportional to their velocity (lines 1300-1340). The process is repeated by the FOR...NEXT loop from lines 1030-1350. The process is repeated by val the new positions are converted to new character cell positions, and if these are different from the last character cell used then the screen is updated.

A subroutine (lines 1390-1660) is used to update the screen, either to remove the old positions and add the new positions, or just to add new positions.

The program will run using a Lear Seigler ADM3A VDU, or an SD VDB8024 video board or any other terminal which uses ESC = xy for cursor positioning.

Customization

As printed the program uses the ESC = xy convention for cursor positioning. For use with VDUs which have different cursor positioning sequences, line 1630 will have to be changed. For memory mapped video boards the line should be replaced by a POKE instruction to put the character directly onto the screen. This will be of the form

```
1630 POKE (base + y*width + x), ASC("1")
```

where the base is the address of the top left corner of the screen and width is the number of characters per line. Some microcomputer BASIC's support PLOT commands.

If the screen size is different from the 80 x 24 format it is necessary to change lines 1000 and 1010 to the new height and width of screen.

With some versions of BASIC the dimensioning of strings in line 10 is unnecessary and wasteful. The program runs under Microsoft BASIC-80, but should run with little or no alteration under other versions of BASIC.

Sample Data

The following input data may be useful both to test the program and also to get a feel for the sort of numbers required.

(a) 2 bodies
mass of second body = 0.3
distance apart = 10
This produces two stable non-intersecting ellipses.

(b) 3 bodies
mass of second body = 0.01
distance apart = 10
third body: position = 10,0
velocity = 0.5
mass = 0.01
Body 2 follows a large slow elliptical orbit whilst body 3 follows a tight fast elliptical orbit. Body 1 moves only slightly because of its large mass. Note that body 3 starts at only half of the speed of body 2 but 3 completes a revolution in less time. This illustrates an interesting principle of spacecraft docking. To catch up with a spacecraft in front of you, you must slow down! Enthusiasts who try speeding up their ship merely fly off into a larger orbit and take longer to complete a revolution. Such hotheads are thus even further behind after one revolution! The correct method of docking is to slow down and dock after one revolution.

(c) 3 bodies
mass of second body = 0.1
distance apart = 10
third body: position = −10,−10
velocity = 3.0
mass = 0.01
This illustrates a "sling-shot" in which body 3 gains great speed by means of an encounter with body 2. Body 3 disappears rapidly from the screen leaving bodies 1 and 2 orbiting each other. These orbits gradually drift across the screen in the opposite direction to body 3.

Program Listing

```
10    DIM X(3),Y(3),A(3),B(3),P(3),Q(3),M(3),R$(10),C$(1)
20    REM**X,Y ARE POSITIONS, A,B ARE VELOCITIES, P,Q ARE
      PLOTTED POSITIONS
30    PRINT TAB(10); "ORBITAL MOTION"
40    PRINT TAB(10); "= = = = = = = = = = = = = = = = = ="
50    PRINT
60    PRINT "Would you like FULL instructions"
70    PRINT "Type YES or NO and press RETURN"
80    INPUT R$
90    IF R$ = "YES" THEN 130
100   IF R$ = "NO" THEN 260
110   PRINT "Reply ' "; R$; " ' not understood.";
120   GOTO 70
130   PRINT "This program analyses the motion of cosmic bodies"
140   PRINT "relative to each other. This may be used to show the
      orbits"
150   PRINT "of planets around a single sun, or the complex orbits"
160   PRINT "of a planet around a double star system. The motion
      of"
170   PRINT "these bodies is displayed on the VDU screen"
180   PRINT "You must specify whether to analyse two or three"
190   PRINT "bodies. The first two bodies are automatically placed
      in"
200   PRINT "mutual orbit around each other, but the third body"
210   PRINT "may be placed in any position and with any velocity."
220   PRINT "Considerable care is needed to avoid the third body"
230   PRINT "shooting off to infinity! The program automatically"
240   PRINT "adjusts the initial velocities so that the centre of"
250   PRINT "mass of the whole system does not move off the
      screen."
260   PRINT
270   PRINT "Would you like a two body or a three body analysis"
```

```
280  PRINT "Type 2 or 3 and press RETURN"
290  INPUT N
300  IF (N-2)*(N-3)=0 THEN 330
310  PRINT "The number or bodies analysed must be 2 or 3"
320  GOTO 280
330  PRINT "Consider two bodies orbiting each other."
340  PRINT "Let the Mass of the first be one, type Mass of the
     second"
350  INPUT M(2)
360  IF M(2)<=0 THEN 340
370  LET M(1)=1
380  PRINT "Type in the distance between the bodies"
390  INPUT D
400  IF D>0 THEN 440
410  PRINT "Distance must be greater then zero"
420  GOTO 380
430  REM**CALCULATE INITIAL POSITIONS AND VELOCITIES
     OF THE TWO PARTICLES
440  LET Y(1)=0
450  LET Y(2)=0
460  LET X(1)=D*M(2)/(M(1)+M(2))
470  LET X(2)=-D*M(1)/(M(1)+M(2))
480  LET A(1)=0
490  LET A(2)=0
500  LET G=D*D*D/(M(1)+M(2))
510  LET B(1)=X(1)*SQR(G*(M(1)+M(2))/D↑3)
520  LET B(2)=X(2)*SQR(G*(M(1)+M(2))/D↑3)
530  PRINT
540  FOR I=1 TO 2
550  PRINT "Body";I
560  PRINT "Position (";X(I);",0)"
570  PRINT "Velocity (0,"; B(I);")"
580  PRINT
590  NEXT I
600  IF N=2 THEN 760
610  PRINT "Type position (X,Y) of the third body"
620  INPUT X(3),Y(3)
630  PRINT "Type velocity (X,Y) components of third body"
640  INPUT A(3),B(3)
650  PRINT "Type Mass of third body. (Mass of body 1 is 1)"
660  INPUT M(3)
670  IF M(3)>0 THEN 710
680  PRINT "Mass must be greater then zero"
690  GOTO 650
700  REM**CHANGE VELOCITIES SO THAT CENTRE OF MASS IS
     STATIONARY
710  LET M=M(1)+M(2)+M(3)
720  FOR I=1 TO N
730  LET A(I)=A(I)-A(3)*M(3)*M(I)/M
740  LET B(I)=B(I)-B(3)*M(3)*M(I)/M
750  NEXT I
760  PRINT "During the simulation, would you like displayed"
770  PRINT "    1) The PATH traced by the bodies"
780  PRINT " or 2) The CURRENT position of the bodies"
790  PRINT "Type 1 or 2 and press RETURN"
800  INPUT C
810  IF (C-1)*(C-2)<>0 THEN 760
820  REM**CLEAR SCREEN
830  FOR I=1 TO 30
840  PRINT
850  NEXT I
860  REM**SET INITIAL VARIABLES
870  LET H1=0
880  LET T=.01
890  FOR I=1 TO N
900  LET P(I)=0
910  LET Q(I)=0
920  IF ABS(X(I))<H1 THEN 940
930  LET H1=ABS(X(I))
940  IF ABS (Y(I))<H1 THEN 960
950  LET H1=ABS(Y(I))
960  NEXT I
970  REM**SPECIFY HEIGHT AND WIDTH OF SCREEN
980  LET H=24
990  LET W=80
1000 LET H0=.5*(H-1)/H1
1010 LET W0=.5*(W-1)/H1
1020 FOR L=1 TO 5000
1030 REM**POSITION BODIES
1040 FOR I=1 TO N
1050 REM**CONVERT X,Y POSITION TO P,Q CHARACTER CELL
1060 LET P1=INT((X(I)+H1)*W0+.5)
1070 LET Q1=INT((Y(I)+H1)*H0+.5)
1080 IF ABS(P1-P(I))+ABS(Q1-Q(I))=0 THEN 1110
1090 REM**CALL SUBROUTINE TO UNPLOT OLD SQUARE AND
     PLOT NEW SQUARE
1100 GOSUB 1400
1110 NEXT I
1120 REM**RE-CALCULATE VELOCITIES OF BODIES
1130 FOR I=1 TO N-1
1140 FOR J=I+1 TO N
1150 LET X1=X(I)-X(J)
1160 LET Y1=Y(I)-Y(J)
1170 LET R=SQR(X1*X1+Y1*Y1)
1180 LET R3=G*T/(R*R*R)
1190 REM**CALCULATE CHANGE IN VELOCITY IN X DIRECTION
1200 LET F=X1*R3
1210 LET A(J)=A(J)+F*M(I)
1220 LET A(I)=A(I)-F*M(J)
1230 REM**CALCULATE CHANGE IN VELOCITY IN Y DIRECTION
1240 LET F=Y1*R3
1250 LET B(J)=B(J)+F*M(I)
1260 LET B(I)=B(I)-F*M(J)
1270 NEXT J
1280 NEXT I
1290 REM**MOVE BODIES A DISTANCE PROPORTIONAL TO
     VELOCITY
1300 FOR I=1 TO N
1310 LET X(I)=X(I)+A(I)*T
1320 LET Y(I)=Y(I)+B(I)*T
1330 NEXT I
1340 NEXT L
1350 GOSUB 1550
1360 PRINT "Simulation finished"
1370 STOP
1380 REM**SUBROUTINE TO UNPLOT AND REPLOT
1390 REM**UNPLOT
1400 IF C=1 THEN 1440
1410 LET C$=" "
1420 GOSUB 1600
1430 REM**REPLOT IF POINT ON SCREEN
1440 IF P1*(P1-W+1)>0 THEN 1550
1450 IF Q1*(Q1-H+1)>0 THEN 1550
1460 LET P(I)=P1
1470 LET Q(I)=Q1
1480 LET C$="3"
1490 IF I=3 THEN 1530
1500 LET C$="2"
1510 IF I=2 THEN 1530
1520 LET C$="1"
1530 GOSUB 1600
1540 REM**CURSOR HOME
1550 P2=0
1560 Q2=0
1570 LET C$=""
1580 GOTO 1620
1590 REM**SUBROUTINE TO PUT CHARACTER C$ AT P(I),Q(I)
1600 LET P2=P(I)
1610 LET Q2=Q(I)
1620 PRINT CHR$(27)+"="+CHR$(Q2+32)+CHR$(P2+32)+C$;
1630 REM**STRING WORKS ON LEAR-SIEGLER ADM3A
1640 REM**MEMORY MAPPED BOARDS MAY NEED SOME
     POKES
1650 RETURN
1660 END
```

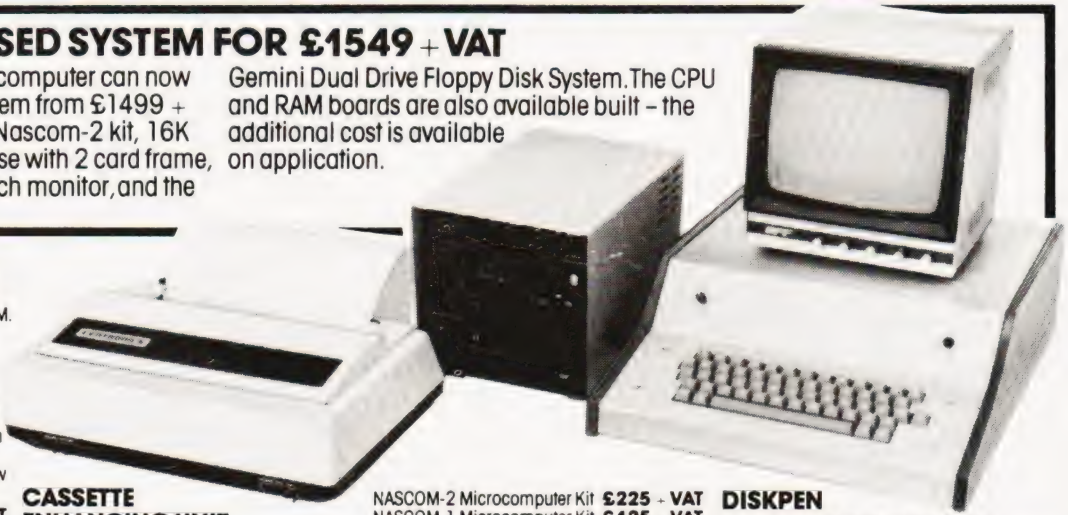
Photograph courtesy of JPL, Pasadena, California

NASBUS COMPATIBLE NEWS

More great deals from 6 Nascom Dealers

A NASCOM-2 BASED SYSTEM FOR £1549 + VAT

The proven Nascom-2 microcomputer can now be bought as a complete system from £1499 + VAT. For this price you get the Nascom-2 kit, 16K RAM board kit, Kenilworth case with 2 card frame, Centronics 737 printer, 10 inch monitor, and the Gemini Dual Drive Floppy Disk System. The CPU and RAM boards are also available built – the additional cost is available on application.



GEMINI G805 FLOPPY DISK SYSTEM FOR NASCOM-1 & 2

It's here at last. A floppy disk system and CP/M.

CP/M SYSTEM. The disk unit comes fully assembled complete with one or two 5¼" drives (FD250 double sided, single density) giving 160K per drive, controller card, power supply, interconnects from Nascom-1 or 2 to the FDC card and a second interconnect from the FDC card to two drives, CP/M 1.4 on diskette plus manual, a BIOS EPROM and new N2MD PROM. All in a stylish enclosure.

Nascom-2 Single drive system. **£450 + VAT**
Nascom-2 Double drive system **£640 + VAT**
Nascom-1 Single drive system. **£460 + VAT**
Nascom-1 Double drive system **£650 + VAT**
Additional FD250 drives ..... **£205 + VAT**

D-DOS SYSTEM. The disk unit is also available without CP/M to enable existing Nas-Sys software to be used. Simple read, write routines are supplied in EPROM. The unit plugs straight into the Nascom PIO.

Single drive system ..... **£395 + VAT**
(please state which Nascom the unit is for)
Certain parts of the CP/M and D-DOS disk systems are available in kit form.
Details available on request.

KENILWORTH CASE FOR NASCOM-2

The Kenilworth case is a professional case designed specifically for the Nascom-2 and up to four additional 8" x 8" cards. It has hardwood side panels and a plastic coated steel base and cover. A fully cut back panel will accept a fan, UHF and video connectors and up to 8 D-type connectors. The basic case accepts the N2 board, PSU and keyboard. Optional support kits are available for 2 and 5 card expansion.

Kenilworth case ..... **£49.50 + VAT**
2-card support kit ..... **£7.50 + VAT**
5-card support kit ..... **£19.50 + VAT**

GEMINI EPROM BOARD

This Nasbus compatible EPROM board accepts up to 16, 2716 or 2708 EPROMs
It has a separate socket for the MK36271 8K BASIC ROM for the benefit of Nascom-1 users. And for Nascom-2 users, a wait state for slower EPROMs. The board also supports the Nascom Page Mode Scheme.

EPROM Board (kit)..... **£55 + VAT**
EPROM Board (built & tested)..... **£70 + VAT**

CASSETTE ENHANCING UNIT

The Castle interface is a built and tested add-on unit which lifts the Nascom-2 into the class of the fully professional computer. It mutes spurious output from cassette recorder switching, adds motor control facilities, automatically switches output between cassette and printer, simplifies 2400 baud cassette operating and provides true RS232 handshake.

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For really interesting and useful interactions with the 'outside world' the Milham analogue to digital converter is a must. This 8-bit converter is multiplexed between four channels – all software selectable. Sampling rate is 4KHz. Sensitivity is adjustable. Typical applications include temperature measurement, voice analysis, joystick tracking and voltage measurement. It is supplied built and tested with extensive software and easy connection to the Nascom PIO.

Milham A-D Converter (built and tested).... **£49.50 + VAT**

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For Nascom ROM BASIC running under Nas-Sys. Supplied in 2 x 2708 EPROMs. Features include: auto line numbering; intelligent renumbering; program appending; line deletion; hexadecimal conversion; recompression of reserved words; auto repeat; and printer handshake routines. When ordering please state whether this is to be used with Nas-Sys 1 or 3. **Price £28 + VAT.**

DUAL MONITOR BOARD

A piggy-back board that allows N1 users to switch rapidly between two separate operating systems. **Price (kit) £6.50 + VAT.**

NASCOM-2 Microcomputer Kit **£225 + VAT**
NASCOM-1 Microcomputer Kit **£125 + VAT**
Built & tested **£140 + VAT**
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CENTRONICS 737 MICRO PRINTER

A high performance, low price, dot-matrix printer that runs at 80cps (proportional) and 50cps (monospaced). This new printer gives text processing quality print. And can print subscripts and superscripts. It has 3-way paper handling and parallel interface as standard. Serial interface is optional. **Price £425 + VAT.** Fanfold paper (2000 sheets) **£18 + VAT.**

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12 x 8 piggy-back board for Nascom-1 offering five-slot motherboard, quality 5A power supply and reliable buffering with reset jump facility. **Price £85 + VAT.**

BITS & PC's PCG

5 x 4 board which plugs straight into Nascom-2. Operates on cell structure of 128 dots, producing 64 different cells. Once defined, each cell may be placed anywhere, any number of times on screen simultaneously. Max screen capacity: 768 cells. Dot resolution: 384 x 256 = 98304. Many other features including intermixing of alpha-numeric characters and pixels. **Price (kit) £60 + VAT.**

GEMINI 64K RAM BOARD

Newly developed Nasbus compatible board that can accommodate up to 64K of RAM including Page Mode facility. **Prices: £110 (16K), £130 (32K), £150 (48K), £170 (64K). Add VAT to all prices.**

All prices are correct at time of going to press and are effective 1st May 1981.

DISKPEN

The powerful text editor written for the Nascom is now available on a 5¼ inch floppy disk with a number of new features. **Price £43.25 + VAT.**

PORT PROBE

Allows monitoring of input and output of Nascom PIO. This board can generate interrupts and simulate handshake control. **Price (kit) £17.50 + VAT.**

HEX & CONTROL KEYPADS

Hexadecimal scratchpad keyboard kit for N1/2: **Price £34 + VAT.**
As above but including (on the same board) a control keypad kit to add N2 control keys to N1. **Price £40.50 + VAT.**

BASIC PROGRAMMER'S AID

Supplied on tape for N1/2 running Nas-Sys and Nascom ROM BASIC. Features include auto line number, full cross-reference listing, delete lines, find, compacting command, plus a comprehensive line re-numbering facility. **Price £13 + VAT.**

GEMINI EPROM-PROG.

2708 (multi-rail) and 2716 (single-rail) EPROM programmer kit controlled by N1/2 PIO. Supplied with comprehensive software for use with Nas-Sys. **Price £35.95 + VAT.**

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All the products are available while stocks last from the Nascom dealers below.
(Mail order enquirers should telephone for delivery dates and post and packing costs.) Access & Barclaycard welcome.

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4 Westgate, Wetherby, W. Yorks.
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Tel: (0926) 512127.

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28 St Judes, Englefield Green, Egham, Surrey TW20 0HB.
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TARGET ELECTRONICS
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Tel: (0272) 421196.

INTERFACE COMPONENTS LTD.
Oakfield Corner, Sycamore Road, Amersham, Bucks.
Tel: (02403) 22307. Tlx: 837788.

HENRY'S RADIO
404 Edgware Road, London W2.
Tel: (01) 402 6822.
Tlx: 262284 (quote ref: 1400).

Dear Sir,
I would like to congratulate Mr W S Lounds for his excellent article in your March edition. It contains much information that is not readily available elsewhere.

I also thought that the "arcade" style game "roadrace" was both entertaining and instructive.

However, it seemed a pity that such excellent graphics should be spoiled by the POKEs to video RAM, when writing to the top line, causing so much "snow".

I would like to offer your readers an alternative method which is much "cleaner".

This involves POKEing the caption data first into non-video RAM and then transferring to line 16 using a machine code routine.

I give below the additions and changes required:-

```
42   DOKE 3412,LEN(A$)
43   FOR J=1 TO LEN(A$)
44   POKE 3413+J,ASC(MID$(A$,
     J,1)):NEXT J
45   M=USR(176)

4046 FOR J=3392 TO 3410 STEP 2:
     READ A:DOKE J,A:NEXT J
4047 RETURN

4170 DATA 21537,19981,21793,
     17933,22049
4180 DATA 4365,3018,-20243,
     -3551,-5648
```

I suppose that by now you know that the DATA given in line 4130 was not entirely correct — the fourth number (−4103) should have been −16103.
Jeff Tock
Witton-le-Wear

Dear Sirs,
Could you publicise by way of your magazine the newly formed York Computer Club for the area in and around York. We hold meetings each Monday evening at the Holgate WMC in New Lane, Acomb, York.

We have a course running on "Basic Programming", Lectures, Demonstrations plus a varied selection of events. There is a Club Newsletter with a diary of events etc. Prospective members are very welcome and should contact me on York 470464 after 6pm.
S Wilson, General Secretary,
York Computer Club
Skelton

Dear Sir,
I would be very pleased to hear from anyone who has ideas or information about using microcomputers on general hospital wards for teaching or management.

I own a Sinclair ZX80 with a 16K RAM pack and would like to be able to put it to use in an 'on ward' teaching situation.

I realise that the Fluid Monitor as packaged by Medicom may soon be leading the field in intensive care units and I feel that any means of improving nursing care and teaching with the use of microcomputers would be a welcome step forward.
Valerie Garlend BSc SRN
12 Hill Park Crescent,
North Hill,
Plymouth,
Devon PL4 83W

Dear Sir,
I am eager to contact fellow lighting engineer micro-users (particularly those who are TRS-80 owners) through your PRINTOUT column, perhaps readers would care to correspond?

Anxious for routines to prevent LISTings on the 16K Level II Model 1 system, or indeed methods to prevent access to programs content or copying, I appeal to fellow readers who may be able to suggest effective methods.

Finally, who has bright ideas for cheap printers and interfaces direct from the CP/U on TANDY's?
S P Brodrick
Bryngwyn,
31 Great Break,
Welwyn Garden City,
Herts AL7 3EZ

Dear Sir,
I recently purchased an "ACORN ATOM" micro and I am experiencing difficulties in saving and loading programs on tape.

I am new to computing and fear that I may be making elementary errors or making wrong assumptions which those used to computing could eliminate for me. First, I assumed that if I had a long program to create, I could save the first part of it on tape with a filename like "Fruit Machine (1)" and then at a later stage load "Fruit Machine (1)", add to it and save the enlarged file with a filename like "Fruit Machine (2)". However, I've found that although I get a sucessful "save" according to the Atom, when I try to load I get a "Checksum" error and the machine hangs up — this although I have switched off the Atom and switched it on again before trying to load. Where am I going wrong? Secondly, it appears that the slightest mark on a tape will prevent me from loading. I'm using ordinary audio tapes — C60 & C90 and a SHIRA Cassette recorder; I brought two Radio Shack C30's (Realistic) from my nearest Tandy Shop and found them to be useless for storing programs. Can you offer me any advice on tapes and which make of tape recorder should be used with an Acorn Atom?
H. Bell
Glasgow

(*According to pages 139-142 of Acorn's manual you should have no problem, although they do supply a command FLOAD which can be used when you get a checksum error. Always use proper computer grade tapes; Pyral, Verbatim etc or good branded ones such as Microdigital supply — audio cassettes are just not reliable enough. The ATOM is very tolerant of cassette machines, I wouldn't like to recommend any specific one. Ed*)

Dear Sir,
Many thanks for your continued support in retaining our User Group, Brunel Computer Club in your publication.

I have now formed a second club at Worle, Weston-super-Mare, may I request that this also be added to your User Group list.

Worle Computer Club
Woodsprings Inn
Function Room
Alternate Mondays 19.00 - 22.30 hrs.

SW Rabone
18 Castle Road
Worle
Weston-super-Mare
Avon
BS22 9JW
Tel 0934-513068

The Brunel Computer Club contact is now

Brunel Computer Club
St. Werburgh's Community Centre
Alternate Wednesdays 1900 - 2200 hrs.

Mr R D Sampson
4 The Coots
Stockwood
BRISTOL
BS14 8LH
Community Centre Tel. 0272 551351

Once again many thanks. It is because of your support that the second club in Worle was formed.
SW Rabone
Bristol

UK101-SUPERBOARD-TRS80 V.GENIE-MICROTAN-SHARP

TOOLKIT for TRS80 and VIDEO GENIE

Adds many new commands AND a MACHINE CODE MONITOR to your TRS/VIDEO GENIE.

TOOLKIT features the following routines, all directly accessible from BASIC, using a unique "command line" structure:

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TOOLKIT is supplied on tape and takes UNDER 2K of user RAM. If bought separately elsewhere, the above routines could cost well over £70. TOOLKIT comes complete with User Booklet and is available ex-stock. Please state memory size when ordering. PRICE £29.95 inclusive.

POSTAGE and PACKING

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VIEW LIST* DELETE FIND AUTO RENUM TRACE MONI

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Allows 8 screen sizes, from 16 x 48 to 32 x 64, PLUS INVERSE VIDEO, all under software control. This is a PLUG-IN device on the UK101; some soldering needed on Superboard (because of unsocketed i.c.'s). Price and release date not available as we go to press - 'phone or write NOW for further details.

CEGMON *official dealer* Other hardware under development.

✻SOFTWARE✻

UK101 and OHIO

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INSURANCE COMPARATOR

J Consadine

Do life policies pay better than a building society for investments? Check it out with this routine

An idea first came to me when approached by a Life Assurance Salesman. He attempted to pursuade me to increase payments on my policies in order that I would receive extra benefits and bonus payments on my retirement (assuming I live that long). The terms looked very attractive but it occurred to me that I could invest my money elsewhere ie Savings Bank, Building Society, etc. The problem was, how do they compare since the insurance salesman quoted only maturity value after, say, twenty years?

This prompted me to write the "Investment" program which would show me the results of investing regular savings at a known interest rate, over any number of years. It, therefore, became possible to project the effect of saving any sum over many years without laborious compound calculations by hand.

The mathematical purists among you will no doubt wish to refine the calculation but it is sufficiently accurate for comparison purposes. So, if you have any money left after the taxman/wife etc, have taken their cut, run the program and see what can be achieved by regular savings — you might be surprised.

Program Listing

```
100   DIM B(100)
110   PRINT "[CLS]"
120   PRINT SPC(9)"[CD]**INVESTMENT PROGRAM"
130   PRINT SPC(9)"####################"
140   PRINT
150   PRINT"[2 CD]THE RESULT OF REGULAR MONTHLY
      SAVINGS"
160   PRINT"MAY BE CALCULATED BY TYPING IN THE"
170   PRINT"APPROPRIATE FIGURES WHEN PROMPTED BY"
180   PRINT"THE COMPUTER"
190   PRINT"[2 CD][REV]PRESS ANY KEY TO CONTINUE"
200   GET A$:IF A$=""THEN 200
210   PRINT"[CLS]"
220   INPUT "[CDMONTHLY PAYMENT[2 CR]*[3 CL]";P
230   INPUT "[CD]NUMBER OF YEARS PAYING IN[2 CR]*
      [3 CL]";Y
240   INPUT "[CD]CURRENT RATE OF INTEREST[2 CR]* [3
      CL]";R
250   PRINT
260   FOR X=1 TO 39:PRINT "*";:NEXT:PRINT
270   FOR N=0 TO Y:B(N)=0:NEXT:REM**ZERO ARRAY
280   S=12*P
290   PRINT"[2 CD]ANNUAL SAVINGS DEPOSITED"
300   PRINTSPC(20)"[REV]=";S;" POUNDS"
310   A=S/2:REM**AVERAGE ANNUAL SAVINGS
320   REM**CALCULATE ANNUAL BANK BALANCE
330   FOR N=1 TO Y
340   B(N)=S+(A*R/100)+B(N-1)+(B(N-1)*R/100)
350   NEXT N:T=S*Y
360   PRINT"[CD]TOTAL INVESTED OVER ";Y;" YEARS"
370   PRINTSPC(20)"[REV]=";T;"POUNDS"
380   PRINT"[CD]INTEREST ACCRUED";
390   IA=(INT((B(Y)-T)*100))/100
400   PRINT"[4 CR][REV]=";IA;" POUNDS"
410   PRINT"[CD]BANK BALANCE AFTER ";Y;" YEARS"
420   B(Y)=(INT(B(Y)*100))/100
430   PRINTSPC(20)"[REV]=";B(Y);"POUNDS"
440   INPUT "[CD]ANOTHER CALCULATION Y/N";A$
450   IF LEFT$(A$,1)="Y" THEN 210
460   STOP
```

2K ZX80

N J Petry

Following in the footsteps of 8K XTRA we fit an extra 1K inside a ZX80

The article entitled '8K XTRA' by S C Adams in the January issue of Computing Today, prompted further development on my ZX80 giving 2K RAM on board.

First, however, one point (not applicable to all ZX80's) appears. To "piggy-back" the 74LS02 on IC12, already set in an IC socket, stops the lid from closing! Inverting the extra chip and placing it over the cut track from IC 13 solves the problems. Double sided stickies will hold it. Then wire up, including pins 14 and 7, to those of IC 12. The remaining pins are used to address extra RAM.

Two 2114 (300nS) RAM chips can be obtained for around £6. These are "piggy-backed" onto ICs3 and 4, but with their pin 8's bent outwards. Using a grounded iron, solder all remaining pins to the corresponding pins of ICs3 and 4. Both upper pin 8's (on new RAM) are linked together, and insulated wire is run from these to pin 1 of the 74LS02.

The remaining pins of the 74LS02 are used as follows:-

1. Link pins 2, 3 and 4 together.
2. Link pins 6 and 10 together.
3. Link pins 9 and 8 to pin 12 (A13.D8.)
4. Run wire from IC 12 pin 12 (MREQ) to pin 5.

The job is now complete although the lid just touches the new RAM. The immediate command PRINT PEEK (8192) should return a value of 1. Machine code can now be POKEd from 8192 to 9216, the existing 1K can be used for the normal BASIC workspace.

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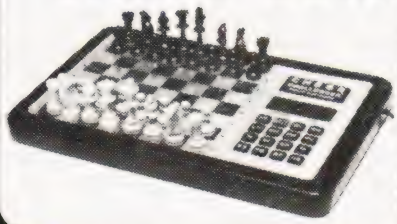

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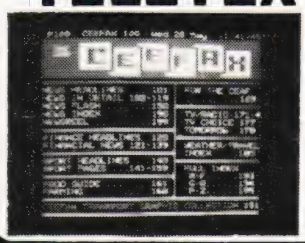

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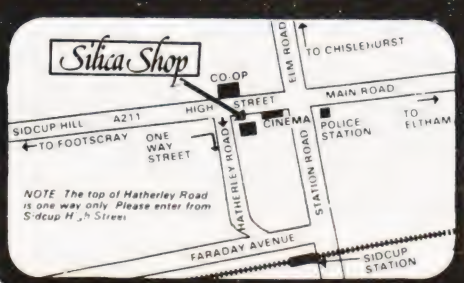

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KEEPING TABS

A special report on a low-cost package

Business packages come in many shapes and sizes and are certainly nothing new in the small systems market. Indeed, they are probably the major area of growth for software houses and many of the hardware manufacturers are seeking to improve their image by moving into this field too. Computers such as the CBM 3032, the SuperPET, and the Apple are all advertised nowadays on their merits as business tools whereas a year ago they were aimed at the pesonal market.

This report was prompted by seeing an advertisment for a complete suite of business programs based on the Apple II whose cost, £99 per unit, seemed to be about the level that many businessmen would be prepared to risk for their first venture into computerising a portion of their business. Called TABS, short for The Accounting Business System, it is wholly British in origin and, from the advertising material, appeared to form the basis of a computerised system that could grow with the needs of the user.

Rather than try out a totally new set of programs in the office I took a stroll down to the City to visit one of the 100+ dealers selling it.

The System Fundamentals

Tailoring software to meet the individual user's requirements is a job that many programmers make their living by. TABS renders their services, to a large extent, unnecessary because the user can configure the system to suit his own needs. A master program disc together with a hardware protection card and an Apple with a minimum of 48K and two 5¼" discs form the basis of the system to which you add your required software packages and a printer if you want hard copy.

The currently available software includes Sales, Purchase and Nominal Ledgers, Stock Control, Payroll and Job Costing with Wordprocessor and Mailing List promised shortly.

Many of the programs interconnect with one another, passing data between, for example, the Sales Ledger and the Stock Control.

Defining your own system is a straightforward, if laborious, process. Reference to the excellent documentation, of which I'll say more in a minute, makes the job even simpler. You can, of course, re-define the system at a later date if circumstances change. A considerable degree of confidence is inspired by the simple reviewer's device of trying to make the machine accept a bad date, the first thing you have to enter. The number of low-cost packages that fail on this simple test is frightening and it's usually a bad indication. If the software house hasn't taken the trouble to get this simple routine working properly then there may be other examples of slack programming waiting to trip you up.

The hardware card that comes with the master program is basically TABS's way of protecting their software copyright. You can make security copies of all the programs, even the master, but there is no way that these can be run on another Apple without the correct hardware card, each is individually coded. This simple device guarantees that unless the owner of the software and the owner of the hardware card are the same then it'll do absolutely nothing — a good thing in this age of piracy.

The Software Suites

I tried out the Purchase and Sales Ledgers together with the Stock Control. Operation is straightforwared, once again practice with the manual will make perfect. Probably the only comment one can make is that each program performed no more and no less than that claimed for it. However, I did find one bug. Nothing to do with TABS, it's a failing of the Apple to look after its keyboard properly so if you press CONTROL C to stop the printer while the disc is being accessed you get an awful mess. Because the system prints from disc files no data should be lost but you'll have to go back to your last operation and start again.

Hopefully, when they get the CP/M version of TABS running they'll choose a computer that doesn't have quirks like this as the recommended machine.

All the software testing was done on a dual disc system with the programs sharing a common data disc on the second drive, the program currently being run located in drive 1 of course. Selection of the program in operation is by menu and full prompting is given, TABS even supply a set of sticky labels to put onto the drives so you shouldn't ever get in a muddle.

Although the system is based on 5¼" drives it is quite possible to load the programs off onto 8" drives, thus gaining a significant increase in storage capacity. You could even go to a hard disc if you wished with some alterations to the basic programs. The documentation gives the storage capacity of the data disc for each option.

Led By The Hand

I've mentioned the documentation a couple of times and it is really superb. I've seen some computers supplied with less and many with poorer produced works. It comes in a ring binder that opens flat, the pages are double sided, and takes you from start to finish in copious detail. Some of the detail is probably a little too much but to a businessman approaching his shiny new toy for the first time this may be no bad thing.

As an example, it takes 31 pages to explain the initialisation in Heathkit-like detail — if you manage to go wrong it's almost definitely your fault!

Overview

The only way to see if TABS will suit you (at this price it'll almost certainly suit your pocket) is to try it out. It is by no means the Rolls Royce of the business software world but it is easy to adapt and seems to work in a straightforward way. It makes a refreshing change from the 'sell it at £XX and then charge £XXX to modify it' approach that some software houses seem to adopt.

TABS also have a novel approach to bugs — after all, no-one's perfect. If you find a new one not only will they sort it out but they award you a fiver — a nice touch. Full software maintainance is available for £99 a year for your suite of programs.

British software leads the world in many fields and it's nice to see some genuine British produced business programs standing up to be counted. My grateful thanks are due to Terry Pool of TABS and Peter Gregory of Midexhouse (Computers) Ltd, their London distributor whose office I invaded, for allowing their software to be poked and prodded. That it survived unscathed is a tribute to both of them.

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6502 PROGRAMMING COURSE

A P Stephenson

Our third episode in this popular series concentrates on some practical programming examples using the 6502

The safe place in memory to hold machine language programs is the second cassette buffer (at least as far as the PET is concerned) which occupies 192 bytes, completely free from the ravages of BASIC. The address range is 826 to 1017 (033A to 03F9 in Hex.)

This is a small amount of memory but remember that 192 bytes of machine code has a relatively enormous capability. Unless your programs are data-bound, this amount of memory will be found more than adequate for experimenting. If you are ambitious and want more memory for coding at the expense of BASIC you can always alter the top of memory string pointers.

In the examples that follow however, we shall always start at a nice round figure; all programs will start at 0340 Hex. Systems other than PET should choose a suitable location, all code is re-locatable.

Loading Procedure

Type SYS 1024 to enter TIM on the 16K PETs or load the monitor tape on 8K PETs.

Now type M 0340,0350 (followed by RETURN of course) This releases twenty-four bytes for display which, I find, is a convenient block to gaze at without putting too much strain on the eyeballs. If your program demands more bytes, it is easy to bring out another block of twenty-four and so on.

Proceed (carefully) to paint over the existing bytes with your bytes using the cursor. Remember that spaces *are* important, the original format of exactly eight bytes per row must be preserved. And, don't forget to press RETURN at the end of each line (after the last byte on the row). Since our programs all start at 0340, simply type, G0340 . . . and hope for the best!

Space For Machine Code

For machine code programs of moderate dimensions, the 192 bytes available in the second cassette buffer is usually more than adequate. For larger programs, the only solution is to pinch some of the space normally inhabited by the BASIC system. Thus, if we have a 16K PET we must consider whether any of this can be spared for machine coding. If so, then it is necessary to modify the pointer which defines the "highest RAM address" available for BASIC.

On new ROM machines this is stored in addresses 52 (lower order byte) and 53 (higher order). Try this out by typing PRINT PEEK(52) ; PEEK(53). With a 16K PET you should get 0 64. This may not be what we expected . . . shouldn't it have been 16,384 ? No, because the "64" is in the higher order byte position and is therefore worth 256 times as much. Feverish activity with the pocket calculator should reveal that 256 x 64 is 16,384 so all is well. We can now alter the second byte of this pointer to set an upper limit on the BASIC preserves. Thus, suppose that we wish to reserve 4K at the top end of memory for machine code. This will entail reducing the second byte from 64 down to 48.

So, to prepare a 16K PET for holding 4K of machine code, first type POKE 53,48. This will allow machine code to occupy the address range 3000 to 3FFF Hex (12288 to 16383 decimal).

For 8K PETs with OLD ROMs, the highest RAM address pointer is stored in 134,135. As it would be too extravagant to pinch 4K from BASIC assume 1K only so to prepare an 8K PET for holding 1K of machine code, first type POKE 135,28. This will allow machine code in the address range 1C00 to 1FFF Hex (7168 to 8191 decimal). Prove these figures as an exercise. Once again for machines other than PET these procedures can be followed according to your documentation.

Setting Out The Program

An array of insipid looking bytes has little meaning to humans so, in examples intended as teaching aids, some additional presentation is needed, even if it has no meaning to the machine. We shall employ Assembler groups written by the side of the machine code to help in understanding the programs. The code will be the mnemonic groups shown in the table and the operands will be in Hex but written the "normal" way round. If the coding is at all complex with loops and jumps, a crude flowchart will also be given. Descriptive details are given initially but will be relaxed in depth of detail as they progress. Don't sneer if they start too simple . . . not all of us are born with machine code tricks up our DNA molecules. Our first example can be examined by loading **PROGRAM 1**, overleaf.

This is the normal display of registers. Note that the AC,XR and YR have been loaded as the program dictated. The B* is informing you that the program terminated with a BREAK instruction. Note that the program counter (PC) has 0345 in it. Why? Because it is pointing to the address of the next byte which *would* have been executed had you not written BRK at the end. All respectable program counters should behave in this civilised fashion. The remaining registers may not have the contents shown above because we have not told them anything yet.

To get the feel of it, modify the program to put a different number in the register and run it again.

We'll now put a single character onto the screen, this routine is given in **PROGRAM 2.**

After you have run it once, try it again with different POKE numbers and different screen addresses . . . this is practice in reading and understanding the POKE and screen tables previously given.

To illustrate the main use of machine code load **PROGRAM 3**.

Enter this code and then type X to return to BASIC. Enter the BASIC segment:

```
10  PRINT CHR$ (147)  Clear screen
20  SYS 832           (832 is decimal for 0340
                      and SYS is BASIC for
                      "Go to machine
                      language address"
30  PRINT"BACK OK"
```

Now RUN and note that our little "A" appeared as before and we must have returned to BASIC for the message to appear at line 30.

Rather than performing a single operation we can use **PROGRAM 3** which illustrates a loop.

This our first attempt a programming a loop so study it carefully. There are 40 "jobs" to do so the index register X is first cleared. It is incremented each time round the loop until the compare instruction detects 28 Hex (40 decimal). The POKE code for "Z" is 1A Hex (26 decimal) and this is stored in successive positions along the bottom row by indexed addressing.

Thus, at the start, the Acc is stored in address 83C0 and, because the contents of X are added to the operand each time round, the Acc contents "creep along" There is an alternative way to code Program 4 which is more efficient. Instead of commencing with X at zero and counting *up* until the compare instruction is satisfied, we can reverse the procedure and make X count *down* for the "end" value of zero. This will save using the compare instruction altogether because the detection of zero is inherent in most branch instructions. The program now becomes that shown as **PROGRAM 4A.**

Note that the starting number in X must be one less (39 instead of 40 decimal) because there is one extra loop before hitting zero. To allow for this, the branch chosen is "branch if plus" which includes zero. Although this way of coding is efficient, it is clearly more error prone than the first method so, at the expense of offending the boffins, avoid it unless the odd byte or so is precious. The first method is easier (or, rather, marginally less horrific).

We can display the full character set of the machine with **PROGRAM 5.**

The screen POKE numbers 0 to 255 decimal (00 to FF Hex) produce the full range of character. The index register and the Accumulator are both increased by one each time round the loop so the screen address *and* the character code progress respectively. Notice that no instruction exists for incrementing the Accumulator but the TXA does it indirectly. The character pattern is formed in the last six lines of the screen.

When you run this program note particularly the speed of the screen "painting". The entire pattern appears "instantaneously" instead of the distinctly visible character-by-character painting of the FOR . . . NEXT loop in BASIC. In fact it is worth the effort to try a direct comparison. Leave the machine code program; type X to return to BASIC and enter this,

```
10  PRINT CHR$ (147):A = 32768
20  FOR J = 0 TO 255 : POKE (A + J),J:NEXT
```

Run this, return to TIM and run the machine code.

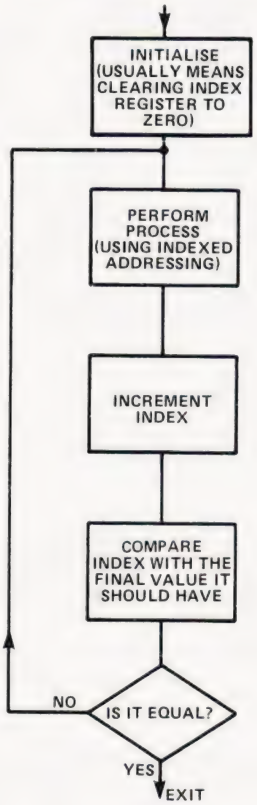
Moving memory around is another useful function, this is illustrated by **PROGRAM 6.**

To see if this works, use the cursor to stick some dummy data in the first block. Then run the program and check that a copy of the data is produced in the second block. Before proceeding with other programs it is worth re-examining the last three for some common pattern running through them. Machine coding techniques rely heavily on the recognition of a general purpose pattern as being the solution to apparently unrelated problems. For example, programs 3,4 and 5 are related because they all perform some process on sequential addresses. In fact we can construct a general purpose flowchart which can be used as a skeleton framework for all sequential processing. The subject of "flowcharts" appears to be under some form of attack by the computing Establishment which suggests that they are not all they were cracked up to be. At the risk of being termed old-fashioned, we shall introduce a flowchart. The two common shapes are the rectangle (the ACTION box) and the diamond (the DECISION box).

General Purpose Flowchart

A flowchart should not be too machine-orientated. It should be a strategic rather than tactical plan and termed in sufficient detail to suggest, rather than define, the corresponding coding.

Thus, to cover the general class of programs which perform identical processes on sequential addresses, the following illustrates the provisional plan:



PROGRAM 1. Load FF into the Accumulator and the two index registers.

```
0340  A9 FF      LDAIM FF
      AA         TAX
      A8         TAY
      00         BRK
```

When you have entered this it should appear like:

```
.: 0340    A9 FF AA A8 00 XX XX XX
.: 0348    XX XX XX XX XX XX XX XX
.: 0350    XX XX XX XX XX XX XX XX
(the "XX" bytes are garbage)
(the ".:" is the monitor response)
```

Now run it by typing G 0340 and the display should look like this:

```
  B*   PC    IRQ   SR   AC   XR   YR   SP
  .:   0345  E62E  B0   FF   FF   FF   F8
```

PROGRAM 2. Display a single letter "A" at the bottom left-hand corner of the screen.

```
0340  A9 01       LDAIM 01      01 is POKE number for "A"
      8D C0 83    STA 83 C0     Screen address of bottom
                                left
      00          BRK
```

PROGRAM 3. Modify PROGRAM 2 above to make it appear as a subroutine and write a short BASIC segment to call it up and return safely to BASIC.

```
0340  A9 01       LDAIM 01
      8D C0 83    STA 83 C0
      60          RTS           BRK is changed to ReTurn
                                from Subroutine
```

6502 PROGRAMMING COURSE

Re-examine programs 3,4 and 5 and try to find their similarity to the flowchart above. It is surprising how wide a range of problems this simple flowchart fits. The block marked PROCESS is not always as simple of course and may in itself contain umpteen loops and tests but the overall generality remains valid. Note that the INITIALISE block is outside the loop. Be careful to interpret the branch instruction correctly . . . a common error situation because of a possible double negative. Remember that a branch out of sequence takes place only if the answer is YES. Thus, in practice, the branch is normally BNE (branch if *not* equal) meaning "YES, it is not equal". This is a typical conflict between the common sense language and the rather brutal logic of the machine code.

Message displays are illustrated by **PROGRAM 7**.

This still corresponds in outline to the previous flowchart. Note the program "ends" with a BRK and the data starts close up to the bottom of it, occupying the addresses 034EH onwards. Those of us who have been spoon fed with BASIC must find it irksome to work out all the code numbers for each character but that's life, ain't it!

Practise linking this with BASIC again by changing the BRK to RTS (opcode 60). The BASIC would be,

```
10  PRINT CHR$ (147) : SYS 832
20  PRINT "BACK OK"
```

Using Existing BASIC Subroutines

Lounging around at the top end of memory is the ROM interpreter for BASIC, a collection of assorted subroutines put together by the brilliant staff of Microsoft. Magazines and PET club writers frequently publish the starting addresses of the most useful ones so that anyone writing machine code can purloin them. However, these notes are primarily intended to teach the elements of coding so there is little point in using other people's subroutines on every possible occasion. Nevertheless, we shall bend the rules on two of them because they enable us to widen the scope of your examples without too much of a strain on the intellect. The two we shall borrow initially are,

FFE4 Get a character from the keyboard and place the ASCII code equivalent in the Accumulator. If no character, place 0 in Acc.

FFD2 Prints the contents of the Accumulator on the screen at the next printing position. No cursor displayed. Character is in ASCII and *not* a POKE code.

PROGRAM 4. Display a complete row of "Z"s on the bottom of the screen.

```
0340  A2 00          LDXIM 00      Clear index register to zero
      A9 1A          LDAIM 1A      Code for "Z"
      9D C0 83   B   STAX 83 C0    Absolute indexed addressing.
      E8             INX           Add 1 to X
      E0 28          CPXIM 28      Has X grown large enough?
      D0 F8          BNE B         Branch back eight bytes. (F8 is -8)
      00             BRK
```

PROGRAM 4A. Modified version of program 4.

```
0340  A2 27          LDXIM 27      Start X with (number of jobs - 1)
      A9 1A          LDAIM 1A
      9D C0 83   B   STAX 83 C0
      CA             DEX           Subtract 1 from X
      10 FA          BPL B         Exit loop when X goes negative
      00             BRK
```

PROGRAM 5. Display the PET character.

```
0340  A2 00          LDXIM 00      Clear X
      8A         B   TXA           Transfer X to A
      9D F8 82       STAX 82 F8    Store A in screen area (indexed addressing)
      E8             INX           Add 1 to X
      E0 FF          CPXIM FF      Compare X with 255 decimal
      D0 F7          BNE F7        Branch back to the TXA instruction
      00             BRK
```

PROGRAM 6. Move the data in addresses 0360 to 036F Hex to another block, 0380 to 038F Hex.

```
0340  A2 00          LDXIM 00
      BD 60 03   B   LDAX 03 60    Place data item from 1st block in Acc
      9D 80 03       STAX 03 80    Store Acc in 2nd block
      E8             INX           Add 1 to X
      E0 10          CPXIM 10
      D0 F5          BNE B         Has X reached sixteen yet?
      00             BRK
```

PROGRAM 7. Display the message "I AM A CLOT" on the bottom line of screen.

```
0340  A2 00          LDXIM 00
      BD 4E 03   B   LDAX 03 4E    Fetch data item
      9D C0 83       STAX 83 C0    Store it in screen memory
      E8             INX
      E0 0B          CPXIM 0B
      D0 F5          BNE B         Have eleven data items been processed?
      00             BRK
034E  09
      20
      01
      0D
      20             These are the POKE numbers
      01             in Hex of the message,
      20             including spaces.
      03
      0C
      0F
      14
```

PROGRAM 8. To test the "Get Character" subroutine at FFE4.

```
0340  20 E4 FF   B   JSR FFE4      This loop waits for a character in Acc
      F0 FB          BEQ B
      00             BRK
```

These two examples are not too strong on excitement but are useful. Try writing them yourself if you think they are trivial. To test them out and to gain confidence in their use try the following programs. The first is the "get" and is illustrated by **PROGRAM 8.**

Run it and press key "A". Examine the registers and note that the Acc contains 41 which is the ASCII code in Hex for "A" Run it several times to verify with different characters.

Our second routine is illustrated by **PROGRAM 9.**

Run it to verify that "A" is printed. Remember the character is at *next* printing position. Thus when you type G0304 the "A" is printed at the end of it and can easily be missed.

Let's use both routines, the code is given in **PROGRAM 10**. The missing cursor gives the screen a ghostly effect after the comfort of BASIC.

Adding It Up. . . .

Although addition is a primitive operation, there are many awkward little facets in machine code which are taken care of automatically when using BASIC. The 6502, like most microprocessors, is only eight bits wide and arithmetic is handled by the machine in the well known two's complement system. When a writer uses the term "well known" it sometimes means he is not too certain of it himself or, conversely, he knows it but can't be bothered to describe it. So, at the risk of boring the initiated, here is a brief reminder of a few of the more bizarre features rather than a full blooded exposition.

The largest positive number possible in an eight bit Accumulator is 01111111 because the first bit on the left indicates the sign (0 = pos, 1 = neg) The value of this is + 127 decimal (7F Hex). The largest negative number in an eight bit Accumulator is 10000000 which the 6502 is content to recognise as −128 decimal (80 Hex). Inconsistent? Not at all, because if you add +127 to −128 you get −1, . . .

```
10000000   −128
01111111   +127
--------
11111111   −1 decimal (FF Hex)
```

What happens if we add −1 to +1, . . .

```
11111111   −1
00000001   +1
--------
00000000   zero
```

Notice that the final carry out which "drops on to the floor" is ignored and yet the answer is right without it! As a matter of fact, this "ignored 1" is popped into the CARRY bit position in the status register. This result is important because it illustrates a strange property of two's complement notation; the presence of a "CARRY" is no indication that the result is invalid. Overflow occurs, as might be expected, if we try to squeeze too large a number into too small a register. If this happens the OVERFLOW bit in the status register is set. The arithmetic unit is able to distinguish between a harmless carry out and an overflow. The distinguishing rule is rather strange; Overflow exists if the carry *in* to the sign bit is different to the carry *out*.

The only addition instruction available is ADC which, as previously defined, is ADd with Carry. Before commencing an addition loop it is necessary to set the carry to zero using CLC, otherwise there may be a spare bit floating around causing havoc. Another precaution is a check for overflow after every addition by using BVS, or its inverse BVC.

PROGRAM 11 illustrates the addition of two numbers. To try this out, enter some number into the 0360 to 036F data area, first with small numbers which will not overflow and then with larger ones which will. Try a run with a few negative numbers mixed in (FFs are idela because these will be — 1s and easy to check). Remember that any Hex number higher than 7F must be a two's complement negative.

Taking It Away!

Subtraction is actually carried out by the machine by adding the complement. Remember before using SBC that, unlike addition, the carry bit must be SET with SEC. This is because the carry is in effect a "borrow" so if it remains at "1" after the subtraction it signifies it wasn't used!

The limitation of +127 and −128 as the largest numbers in the accumulator would appear to be a shocking limitation on the arithmetic capabilities but it is possible to overcome this limitation by using more than one memory location for each number. For example, suppose two adjacent addresses are used for each number and the programmer treats the interpretation as two bytes in "series" (placed end to end). The bit which would normally be the sign bit in the lower order byte is ignored and treated as a normal magnitude bit. The resultant number can now be considered as a 16 bit word with, as usual, just one sign bit at the end and 15 bits of magnitude. The largest positive number would then be 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 which is 7FFF Hex or 32,767 decimal.

There is a simple rule to arrive at the largest positive number in a word of N bits, by using the equation;

$$\text{Largest positive number} = 2^{(N-1)} - 1$$

The largest negative number is $2^{(N-1)}$, one more. Naturally, this equation is only of use if you know your powers of two or have access to tables of 2^N.

There is no reason why three or even more locations cannot be used for each number providing the "sign bits" in the middle are always ignored. There is a price to pay however, . . . programming in multiple precision bytes is not the smooth operation which many text books would have us believe. In fact, it is downright awkward.

For a "straightforward" example, we shall assume that one number is stored in addresses 0360 and 0361 (with the lower order byte in 0360) and the other number in 0362 and 0363. These are to be added and the result stored in 0364 and 0365. It may help to visualise the problem diagramatically as follows:

0360	FF	Low order byte	1st number
0361	01	High order byte	
0362	53	Low order byte	2nd number
0363	0E	High order byte	
0364		Low order byte	Result to be
0365		High order byte	stored here

The scheme will be to add the two low order bytes of each number and store result then add the two higher order bytes and store. The carry must be cleared before adding the lower order bytes but taken into account when adding the higher order bytes. Similarly overflow status is irrelevant during the first addition but important during the second.

Finally, **PROGRAM 12** illustrates double precision addition.

The arbitrary numbers chosen are. . .

```
01FF
0E53
-----
1052   Total in Hex
```

Run the program after entering the numbers. Check that the contents of 0364/5 agree with the above total. Try it several times with different numbers but note that the program does *not* include test for overflow.

Our next expedition into the world of the 6502 will concentrate on making the machine talk to the outside world.

6502 PROGRAMMING COURSE

PROGRAM 9. To test the "Print Accumulator" subroutine at FFD2.

```
0340  A9 41      LDAIM 41     ASCII code for "A"
      20 D2 FF   JSR FFD2
      00         BRK
```

PROGRAM 10. Use both subroutines to make the keyboard print on the screen until the asterisk is typed.

```
0340  20 E4 FF  B  JSR FF E4   Get character from keyboard
      F0 FB        BEQ B
      20 D2 FF     JSR FF D2   Print Acc on screen
      C9 2A        CPXIM 2A
      D0 F4        BNE B       Tests for * (ASCII 2A)
      00           BRK
```

PROGRAM 11. Add the numbers in the block of addresses 0360 to 036F Hex and store the result in address 0370. As soon as overflow is detected, print "V" on the bottom of the screen.

```
0340  18          CLC
      A9 00       LDAIM 00     Initialise
      AA          TAX
      7D 60 03 B  ADCX 03 60   Indexed addition
      70 09       BVS S        Check for overflow
      E8          INX
      E0 10       CPXIM 10
      D0 F6       BNE B
      8D 70 03    STA 0370     Store total
      00          BRK          Stops here if no overflow
      A9 16    S  LDAIM 16     Hex for "V" in Acc
      8D C0 83    STA 83 C0    Store in screen
      00          BRK

0360 ]
     | Numbers to be added
036F ]
```

PROGRAM 12. Assume a double byte number is in 0360/0361 and another in 0362/0363. Add them and store result in 0364/0365.

```
0340  AD 60 03   LDA 03 60   Load lower order byte 1st number
      18          CLC        Ensure carry is clear
      6D 62 03    ADC 03 62  Add lower order byte 2nd number
      8D 64 03    STA 03 64  Store result
      AD 61 03    LDA 03 61  Load higher order byte 1st number
      6D 63 03    ADC 03 63  Add higher order byte 2nd number
      8D 65 03    STA 03 65  Store result
      00          BRK
0360  FF ]
0361  01 ]                   1st number (arbitrary)
0362  53 ]
0363  0E ]                   2nd number (arbitrary)
0364 ]
0365 ]                       Result?
```

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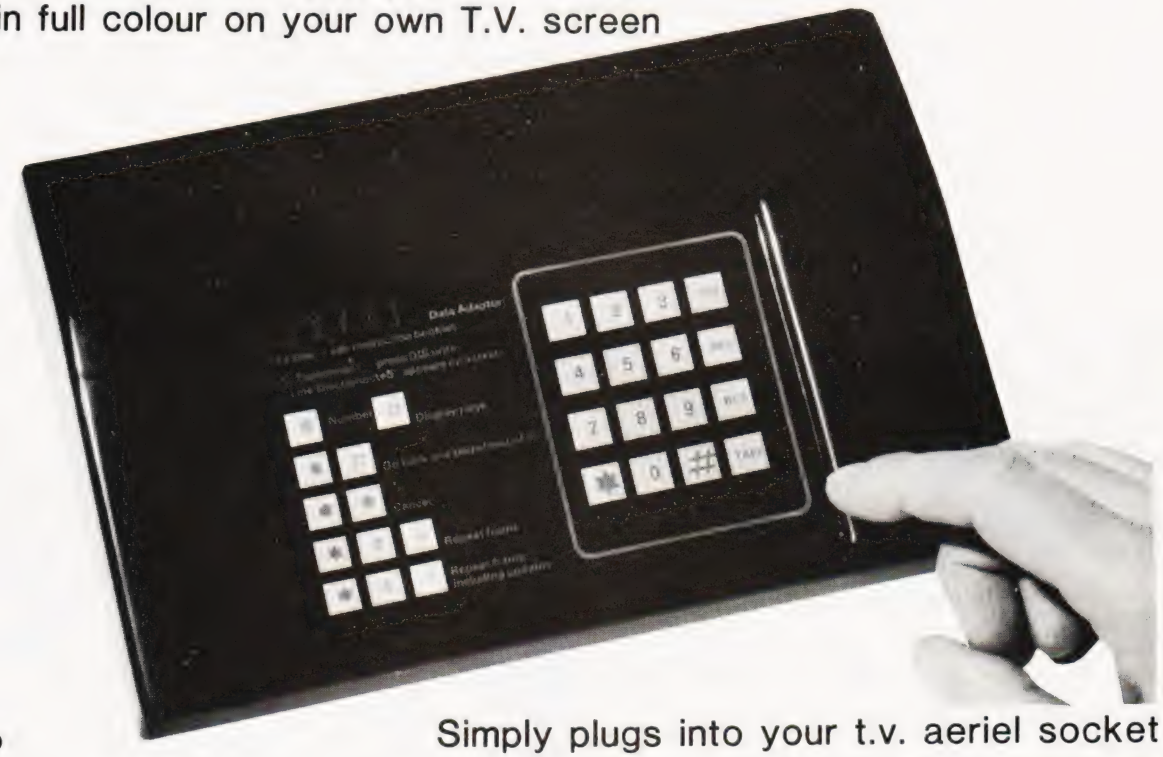

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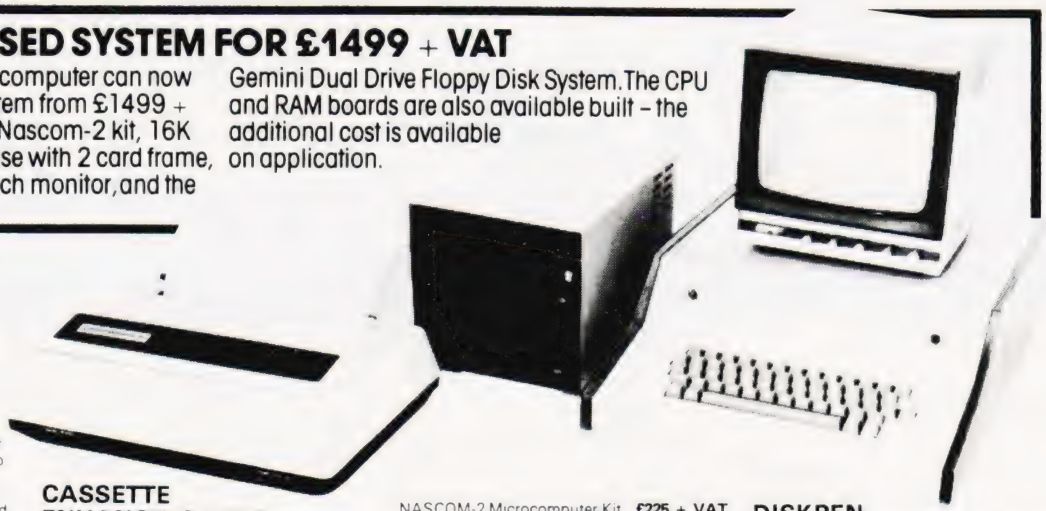

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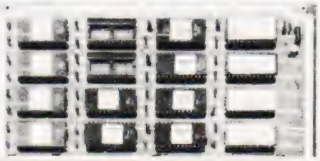

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Systems is our subject this month with more machines and a new, easier to read format.

The next few pages of the magazine are given over each month to a comprehensive guide to what's available on the UK computer market. The information is intended to be used as a quick reference to the vital statistics of the various micros, both by people looking to make their first purchase and those seeking to upgrade. The purpose of this 'Guide to the Guide' is to explain how to interpret the information that follows in order to get the most out of it.

From The Top

Each bold type section contains the range of computers manufactured by that company. The actual manufacturer may not be involved in direct selling to the public, Atari for example. In cases like this we give you the name and address of the major UK distributor. Several companies have one major distributor and several other sources, the address we give is still that of the major source — the company you should contact for further information or the location of your nearest dealer.

The next important detail is the type of **CPU** that's used in the computer. If your requirements call for a specific CPU this entry is essential, if you are merely interested in high-level language programming then the CPU is probably not so critical.

Remember Remember

The computer's memory capacity is the next item on the list. **RAM** stands for Random Access Memory, the kind you load your programs into as opposed to ROM(Read Only Memory) which is what the manufacturer loads his software into. Generally one figure is quoted and this is the amount that is supplied with the basic machine, 48K for example. If there are two figures, 8K/32K as in the case of the Commodore PET, this indicates the range of memory that's available.

The 'K' stands for 'binary thousand' (1024) and so an 8K machine contains 8192 bytes of user memory. A byte is a collection of eight bits and is the basic unit of computer storage. Most of the systems in the Guide are based on eight bit microprocessors and these have an addressing capability of 64K, that's 65,536 bytes. Sometimes you may see a figure greater than this in the RAM entry, it's not a misprint, and in these cases the manufacturer is using a special technique called 'bank selection' to increase the amount of memory that can be supplied, 227K in the case of the NASCOM.

Storage And I/O

When you have produced a computer program that works you will want to store it away somewhere, it disappears from RAM when you turn the power off. The usual method for personal computers is to use a conventional cassette recorder, special tape is recommended. The **CASS** entry tells you whether this facility exists and to what standard, if known. Typical standards here are CUTS, short for Computer Users Tape System, and Kansas City, named after the place where the standard was defined. These convert the digital information inside the computer into a series of tones which can be recorded onto magnetic tape. The speed of storage and retrieval is worth checking, a fast speed such as 1200 or 2400 baud is convenient but inherently less reliable than a slow speed such as 300 baud. The term baud originally came from the telegraphic industry and refers to the number of transitions occurring per second, it is *not* the number of bytes that are transferred per second. Ideally your computer should offer a choice of baud rates, 300 and 1200 is a typical example, and this allows you to save a master copy for security and make a second, faster version for day-to-day use.

A more expensive but generally faster and more flexible (no pun intended) method of storing programs is the floppy disc and this is shown in the **DISC** entry. These come in two sizes, 5¼" and 8", and are available in single and double sided and single and double density versions as well as combinations of the two. Obviously you'll be able to fit more onto an 8" disc than a 5¼" one and these tend to be used in professional and small business systems as they are more suited to the heavy usage. For people with a lot of information to store there is another type of disc knowns as a 'hard disc', shown as Hd in the list. These are capable of holding millions of bytes as opposed to the tens or hundreds of thousands found on the floppy disc. They do, however, carry a large price tag. A typical example of a hard disc based system is the Cromemco Z2H which is fitted with a 10Mb (megabyte) Winchester technology hard disc unit.

Getting the information in and out of the computer to a printer or a Visual Display Unit requires the computer to have input/output capability and this is indicated by **I/O** in the table. There are three major types of I/O and two specials. The most common type is serial, indicated by SER, and this can be RS232, V24 or 20mA depending on the peripheral being used. The second type is parallel, indicated by PARA, which is effectively just an extension of the computer's data bus with some control capability built in — an oversimplification but easier to visualise. The third type that is commonly found is IEEE which is a special sort of parallel interface that allows many different peripherals to share the same connection to the computer. It is normally found in machines that are used in a scientific environment, the PET is a notable exception.

The two specialised forms of I/O are the dedicated printer port, shown as PARA.P, which allows a Centronics type printer to be fitted and the bus which is used for the expansion of the system, SS50 and S100 are typical.

The Soft Edge

If you are intending to program in a high level language, one that uses words rather than the machine code of the CPU, then look at the entries beside **BASIC** and **Other**. The most common language is BASIC although others such as Pascal are rapidly gaining in popularity. The **m/c** entry is also important here because it indicates whether the system will allow you to program it in machine code, the number indicates the amount of ROM that the manufacturer has fitted his monitor into.

An entry such as CP/M in the m/c slot shows that the discs are running under control of a Disc Operating System, DOS for short, and this often gives you access to a large quantity of ready-made programs and languages.

The Price You Pay

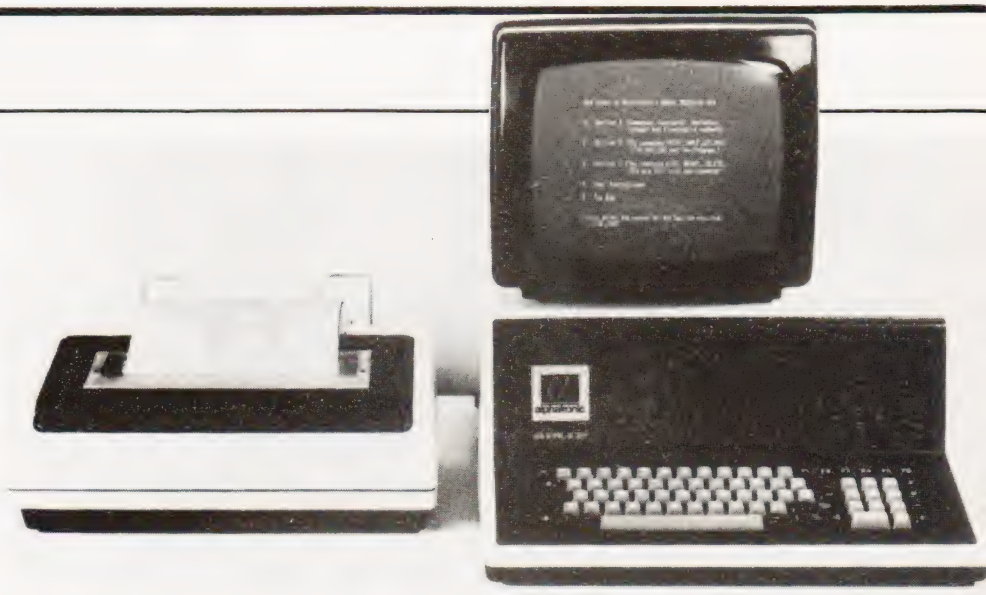
The figure in the **£** entry is obviously the price of the given system. Although these are checked regularly for their accuracy the manufacturers do tend to change them at short notice so it is well worth checking.

The **Extras** and **Applications** entries give a brief idea of the support and ex-

pansion capabilities of the system and the area in which it is likely to perform best.

When you have compiled a short-list of the systems that seem to meet your needs you should try to get 'hands-on' experience with them. Always make sure that your dealer is a recognised one and, if possible, ensure that he is a member of the Computer Retailers Association, the CRA.

Over the years Computing Today has **Reviewed** many of the systems listed here and those that we have looked at hare indicated. Copies of the reviews are available from our offices, they cost £1 each.



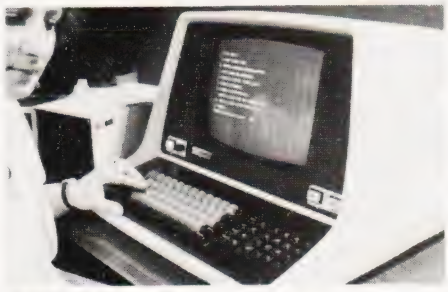
ABC Computers

ABC-24
Dist:- Ragen International
Assets House, 17 Elverton Street,
London SW1P 2QG
01-828 2355

CPU	Z80A
RAM	64K
I/O	2 SER 1 PARA
CASS	–
BASIC	BASIC-80 M BASIC
Other	Various
DISC	2x5¼"
m/c	CP/M, MP/M

£3,000

Extras:- Two more 5¼" drives, Wordstar, Grafcom packages etc.
Applications:- Integral system with dual discs and VDU



ACT Microcomputers

SYSTEM 800
Dist:- ACT (Computers),
Radclyffe House,
66-68 Hagley Rd, Edgbaston,
Birmingham, B16 8PF
021-455 8686
+ growing regional network

CPU	6502
RAM	46K
I/O	SER PARA
CASS	N/A
BASIC	Yes
Other	Various
DISC	2x5¼"
m/c	MDOS

£3,950-8,950

Extras:- 8" disc, printers, modems
Applications:- Stand alone business system that can also run most PET software.

Acorn Computers

ATOM
Dist:- Acorn Computers
4A Market Hill, Cambridge
0223-312772.

CPU	6502
RAM	2K/11K
I/O	BUS PARA
CASS	CUTS
BASIC	8K
Other	FP option
DISC	
m/c	YES

£125 kit, £150 built

Extras:- Colour graphics, enhanced BASIC
Applications:- Cased single board with BASIC, can connect to Eurobus
Reviewed:- April '81

ACORN
Dist:- As ATOM

CPU	6502
RAM	1K/8K
I/O	PARA BUS
CASS	CUTS
BASIC	NO
Other	NO
DISC	NO
m/c	2K

£65 upwards

Extras:- Rack based expansion capability inc Prestel.
Applications:- Single board controller with piggy back Hex + I/O.
Reviewed:- Aug '79

Adler Business Systems

ALPHATRONIC P1
Dist:- Adler Business Systems Ltd.,
27 Goswell Road, London EC1M 7AJ.
01-250 1717

CPU	8085A
RAM	48K
I/O	2 SER, BUS
CASS	–
BASIC	Extended
Other	Soon
DISC	5¼" DD
m/c	CP/M

£1,550-2,345

Extras:- Second 5¼" drive.
Applications:- Small business desktop system with detached 12" screen and optional printer.

ADDS

ADDS SYSTEM 75
Dist:- ADDS (UK) Ltd.
137 High Street,
New Malden, Surrey.
01-949 1272
Sold through dealer network.

CPU	8085A
RAM	52K
I/O	SER COMS
CASS	N/A
BASIC	YES
Other	FORTRAN uCOBOL
DISC	2x8"
m/c	ADOS

£4,000 upwards, less printer

Extras:- Floppy, printer, system software
Applications:- Complete business system with supplied software and communications interface

Apple Computers

APPLE II
Dist:- Microsense,
Finway Road, Maylands Ave,
Hemel Hempstead, Herts HP2 7LE.
0442-48151
Over 200 regional dealers

CPU	6502
RAM	16K/48K
I/O	Various
CASS	1500 bps
BASIC	2 versions
Other	Various
DISC	OPT
m/c	2K

£695 upwards

Extras:- Various discs, colour graphics, I/O
Applications:- Neat cased system with excellent I/O capability including Prestel

APPLE III
Dist:- As APPLE II

CPU 6502A
RAM 96K/128K
I/O Various
CASS —
BASIC Business BASIC
Other Pascal, FORTRAN
DISC 5¼"
m/c Apple SOS
Approx **£**2,500

Extras:- Up to three more discs. Wide range of peripherals
Applications:- Small business machine but still has overtones of the "personal" market

Atari

ATARI 400
Dist:- Ingersoll Electronics
202 New North Road,
London N1 7BL.
01-226 1200

CPU 6502
RAM 8K/16K
I/O SER
CASS YES
BASIC 18K
Other
DISC
m/c shared
£400

Extras:- Printer
Applications:- Programmable games system grown up to home computer.

ATARI 800
Dist:- As Atari 400

CPU 6502
RAM 16K 48K
I/O SER
CASS YES
BASIC 18K
Other
DISC
m/c shared
£750

Extras:- Printer, discs, plug in software, modem
Applications:- Expanded version of 400 with wider applications

Athena

ATHENA 8285
Dist:- Butel-Comco Ltd.
50 Oxford Street,
Southampton, Hants SO1 1DL.
0703-39890

CPU 8085A
RAM 64K
I/O SER
CASS N/A
BASIC YES
Other Various
DISC 2x5¼"
m/c DOS

£3,380 upwards

Extras:- 8" discs, printer, wide range of software
Applications:- Complete integral desktop system

Attache

ATTACHE
Dist:- Friargrove Systems,
Suite 62, Outer Temple,
222 The Strand,
London WC2R 1BA

CPU Z80
RAM 64K
I/O SER
CASS N/A
BASIC YES
Other Various
DISC 2x8"
m/c CP/M
£8,000

Extras:- Hard disc,
Applications:- Complete S100 based system with VDU, printer and software

Cifer

CIFER 2684
Dist:- Roham Computing,
52 Coventry Street, Southam,
Warwickshire CV33 0EP
092681-4045

CPU DUAL Z80
RAM 64K
I/O 3 SER, PARA.P, IEEE
CASS —
BASIC Various
Other Various
DISC Single 5¼"
m/c CP/M
£1,764-2,234

Extras:- Up to four 5¼" or 8" floppies, orange or green VDU.
Applications:- VDU based system with single integral disc. Business and scientific.

Commodore Systems

PET
Dist:- Commodore,
360 Euston Road, London NW1 3BL.
01-388 5702
+ many regional dealers.

CPU 6502
RAM 8K/32K
I/O IEEE PARA
CASS YES
BASIC 8K Microsoft
Other Forth Pascal COMAL
DISC OPT
m/c TIM (16 & 32K only)
£550 upwards

Extras:- Discs, printer, many options
Applications:- Original complete personal system
Reviewed:- December '79

SUPER PET (8032)
Dist:- As PET

CPU 6502
RAM 32K
I/O IEEE PARA
CASS YES
BASIC BASIC 4.0
Other Pascal
m/c TIM
DISC OPT
£700 approx

Extras:- 5¼" discs. Choice of printers, range of business software
Applications:- "Super" personal computer or small business machine

Compshop

UK 101
Dist:- CompShop
14 Station Road, New Barnet,
Herts EN5 1QW
01-441 2922

CPU 6502
RAM 4K/8K
I/O SER PARA
CASS YES
BASIC 8K Microsoft
Other NO
DISC
m/c 2K
£199 kit, £249 built

Extras:- Memory, I/O, kit or built
Applications:- UK implementation of Superboard

Compucolor

COMPUCOLOR II
Dist:- Dyad Developments,
The Priory, Great Milton,
Oxon OX9 7PB
08446-729.

CPU 8080
RAM 8K/32K
I/O SER PARA
CASS NO
BASIC YES
Other NO
DISC 5¼"
m/c DOS
£1,200

Extras:- Second disc unit.
Applications:- Integral colour graphics system with limited expansion capabilities.
Reviewed:- June '79 & July '80

Cromemco

CROMEMCO SYSTEM 2
Dist:- Comart Ltd,
PO Box 2, St Neots,
Huntingdon, Cambs PE19 4NY.
0480-215005
plus Datron & Edinburgh Micro Centre

CPU Z80
RAM 64K
I/O SER PARA.P
CASS N/A
BASIC Various
Other Various
DISC 2x5¼"
m/c CDOS
£2,095-£7,000

Extras:- Hard option disc, multiple user capability, printer, etc.
Applications:- Development system, S100 based, with a wide range of software

CROMEMCO Z2H
Dist:- As SYSTEM 2

CPU	Z80A
RAM	64K
I/O	SER PARA.P
CASS	N/A
BASIC	Various
Other	Various
DISC	10Mb Hd
m/c	CDOS

£5,373 upwards.

Extras:- Up to 6 hard discs, 8" floppies
Applications:- Development system, Fast data processor and data base with multi-user capability.

CROMEMCO SYSTEM 3
Dist:- As SYSTEM 2

CPU	Z80A
RAM	64K
I/O	SER PARA.P
CASS	N/A
BASIC	Various
Other	Various
DISC	2x8"
m/c	CDOS

£3,745-£9,000

Extras:- Discs (inc hard), multi-user capability, printers, etc.
Applications:- S100 based professional system with a wide range of applications.

Digital Microsystems

DSC-2
Dist:- Modata Ltd,
30 St Johns Road, Tunbridge Wells,
Kent TN4 9NT.
0892-41555.

CPU	Z80A
RAM	64K
I/O	SER PARA
CASS	N/A
BASIC	Yes
Other	Various
DISC	2x8"
m/c	CP/M

£3,525-7,645

Extras:- Hard disc, extra floppies, various software
Applications:- Business machine of US origin.

DSC-3
Dist:- As DSC-2

CPU	Z80A
RAM	64K
I/O	SER PARA
CASS	N/A
BASIC	Yes
Other	Various
DISC	2x8"
m/c	CP/M

£3,445-6,995

Extras:- Hard disc, extra floppies.
Applications:- Can use one serial interface in RS422 mode and act as a Master/Slave in a network.

HDS-4000
Dist:- As DSC-2

CPU	Z80A
RAM	64K
I/O	SER PARA
CASS	N/A
BASIC	Yes
Other	Various
DISC	2x8" + Hd
m/c	CP/M

£6,745-7,645

Extras:- More disc storage
Applications:- Choice of two sizes of hard disc make for medium sized DP use.

Equinox

Series 5000
Dist:- Equinox Computer Systems,
16 Anning Street, New Inn Yard,
London EC2A 3HB.
01-739 2387.

CPU	Z80
RAM	16K/56K
I/O	2 SER PARA
CASS	N/A
BASIC	YES
Other	Various
DISC	2x5¼"
m/c	CP/M

£1,500 - £2,500

Applications:- S100 based commercial, scientific or educational usage

Equinox 200
Dist:- As Series 5000

CPU	Z80
RAM	64K/512K
I/O	6 SER PARA
CASS	N/A
BASIC	YES
Other	Various
DISC	10 Mb Cart
m/c	—

£7,500 upwards

Extras:- Cartridge discs up to 1200 Mb
Applications:- Cartridge disc based S100 multi user system

Equinox 300
Dist:- As Series 5000

CPU	16 bit
RAM	64K/256K
I/O	6 SER
CASS	N/A
BASIC	YES
Other	—
DISC	10 Mb Cart
m/c	—

£10,000 upwards

Extras:- Cartridge discs up to 1200 Mb
Applications:- Sixteen bit micro based multi-user system

Series 8000
Dist:- As Series 5000

CPU	Z80
RAM	64K/256K
I/O	2 SER 1 PARA
CASS	N/A
BASIC	YES
Other	Various
DISC	2-4 8"
m/c	CP/M

£2,500 - £5,000

Applications:- Multi user upgrade of 5000 with greatly increased storage capacity

Eurocalc

EUROC
Dist:- Eurocalc Ltd,
128/132 Curtain Road,
London EC2.
01-729 4555.
+ Regional Distribution network soon

CPU	8080
RAM	64K
I/O	PARA
CASS	N/A
BASIC	YES
Other	Various
DISC	2x8"
m/c	CP/M

£8,000

Extras:- Printers, WP keyboard, hard disc
Applications:- Plessey manufactured system supplied complete with software and hardware.

Exidy

SORCERER
Dist:- Liverport Data Products,
The Ivory Works,
St. Ives, Cornwall.
0736-798157.
+ regional dealers.

CPU	Z80
RAM	16K/48K
I/O	SER PARA
CASS	2
BASIC	Plug In 8K
Other	On disc
DISC	OPT
m/c	4K

£749 upwards

Extras:- Discs, printer, S100 adapter, ROM PACs.
Applications:- Keyboard based system using 'plug-in' software and expanding to discs.

Gemini

GEMINI
Manuf.:- Gemini Microcomputers,
Oakfield Corner, Sycamore Road,
Amersham, Bucks.
02403-22307.

CPU	Z80A
RAM	64K
I/O	Serial
CASS	N/A
BASIC	YES
Other	—
DISC	2x5¼"
m/c	CP/M

£575 - £1,075

Heath Electronics

HEATHKIT H8
Dist:- Heath Electronics,
Bristol Road, Gloucester GL2 6EE.
0342-29451.
+ London shop (01-636 7349).

CPU	8080
RAM	4K/56K
I/O	Various
CASS	300/1200 baud
BASIC	YES
Other	Various on disc
DISC	OPT
m/c	4K

£275 upwards

Extras:- Discs, printer, VDU
Applications:- Bus based kit system of superb quality, large expansion possible

Hewart Microelectronics

HEWART 6800S
Dist:- Hewart Microelectronics,
95 Blakelow Road, Macclesfield,
Cheshire SK11 7ED.
0625-22030.

CPU	6800
RAM	16K 32K
I/O	SER PARA
CASS	2
BASIC	OPT 8K
Other	Pascal
DISC	
m/c	1K 2K

£299 inc. keyboard

Extras:- 6809 upgrade, floppy discs using FLEX, case
Applications:- Naked 6800 development system.

HEWART 6800 MK4
Dist:- As 6800S

CPU	6800
RAM	16K/48K
I/O	Choice
CASS	2
BASIC	OPT
Other	OPT
DISC	OPT
m/c	1K

£160 upwards.

Extras:- SS50 range of boards.
Applications:- Naked bus based system, found useful in education/control.

Hewlett Packard

HP 85A
Dist:- Hewlett Packard,
Personal Computation Group,
308-314 Kings Road, Reading,
Berkshire.
0734-61022.

CPU	CUSTOM
RAM	16K/32K
I/O	IEEE, BCD, SER, GPIO
CASS	CART
BASIC	32K
Other	Assembler
DISC	OPT
m/c	NO

£2,012 inc VAT

Extras:- All HP range of goodies.
Applications:- Integral printer system for desktop scientific use.
Reviewed:- April '80 & June '80

HP83
Dist:- As HP85

CPU	Custom
RAM	16K/32K
I/O	IEEE, SER, BCD, GP10
CASS	–
BASIC	32K
Other	Assembler
DISC	OPT
m/c	No

£1,391 inc VAT

Extras:- All HP range of goodies.
Applications:- As the HP85 but without integral printer and tape cartridge units.

Interec Data Systems

SUPERBRAIN
Dist:- Sun Computers,
138 Chalmers Way,
North Feltham Trading Estate,
Feltham, Middx.
01-751 6695.
Many other UK sources.

CPU	2xZ80
RAM	32K/64K
I/O	SER
CASS	N/A
BASIC	YES
Other	Various
DISC	2x5¼"
m/c	CP/M

£1,950 upwards

Extras:- 8" disc, standard software.
Applications:- Smart desktop system for small business use. Can be expanded using S100 bus.

Ithaca Intersystems

ITHACA INTERSYSTEM 2
Dist:- Transam,
59-61 Theobalds Road,
London WC1.
01-405 5240.
+ regional dealers.

CPU	Z80A
RAM	8K/64K
I/O	Various
CASS	N/A
BASIC	YES
Other	Various
DISC	5¼" or 8"
m/c	CP/M

£700 upward

Extras:- Full range of S100 boards to IEEE spec.
Applications:- Flexible system that can be adapted to a wide range of uses.

ITT Consumer Products

ITT 2020
Dist:- Telefusion Ltd.,
61 Queens Square, Bristol.
0272-211446.
+ many regional stockists.

CPU	6502
RAM	16K/48K
I/O	Various
CASS	YES
BASIC	Various
Other	Pascal
DISC	OPT
m/c	2K

£750 - £1,500

Extras:- Discs, Prestel, printers.
Applications:- As Apple II, compatible UK version with standard colour graphics.
Reviewed:- March '80

LSI Computers

SYSTEM M-TWO
Dist:- LSI Computers,
Copse Road, St. Johns,
Woking, Surrey GU21 1SX.
04862-23411.

CPU	8085
RAM	64K
I/O	SER
CASS	–
BASIC	YES
Other	–
DISC	2x8" 1 x Hd
m/c	–

Applications:- Small to medium sized business

Luxor

ABC 80
Dist:- CCS Microsales,
7 The Arcade,
Letchworth, Herts.
04626-73301.

CPU	Z80
RAM	16K/40K
I/O	IEEE SER
CASS	YES
BASIC	16K
Other	Pascal
DISC	2x5¼"
m/c	2K

£749

Extras:- Mainly software, I/O
Applications:- Complete cased system, Viewdata compatible

Memory Computers

SYSTEM 7101
Dist:- Memory Computers (UK) Limited,
960 High Road,
London N12 9RY.

CPU Z80
RAM 64K/256K
I/O 2 SER, 1 PARA
CASS –
BASIC Microsoft V5.2
Other Various
DISC 2 or 4 5¼" DSDD
m/c 4K/CP/M
£5,950 inc printer

Extras:- Four 8" floppies, 10Mb Winchester, extra printer.
Applications:- Complete VDU based system with Intelligent Terminal capability, well established in Europe.

Microdata Computers

MICROLINK 1
Dist:- Microdata Computers,
Belvedere Works, Bilton Way,
Pump Lane Industrial Estate,
Hayes, Middx UB3 3ND.
01-848 9871.

CPU Z80/F8
RAM 16K/32K
I/O SER PARA
CASS CUTS 1200 baud
BASIC 8K
Other Pascal soon
DISC NO
m/c 3K
£3,500 upwards

Extras:- Printer, modem, etc.
Applications:- Portable data terminal using plasma flat screen display

Micro V

MICROSTAR 45
Dist:- Microsense
Finway Road, Maylands Avenue,
Hemel Hempstead, Herts HP2 7LE.
0442-48151.
+ small dealer network.

CPU 8085A
RAM 64K
I/O SER
CASS N/A
BASIC YES
Other Various
DISC 2x8"
m/c *DOS CP/M
£4,800

Extras:- 20 Mb hard disc, VDU, printer
Applications:- Multi user business system

Midwest Scientific Instruments

MSI 6800 SYSTEMS
Dist:- Strumech,
Portland House, Coppice Side,
Brownhills, Walsall,
West Midlands.
05433-4321.

CPU 6800
RAM 16K/56K
I/O SER
CASS OPT
BASIC YES
Other Various
DISC OPT
m/c 1K + FDOS
£1,200 upwards

Extras:- Floppies, hard disc, printer, VDU.
Applications:- Ready built SS50 system expanding to full "System 12" with hard disc.

Nascom Microcomputers

NASCOM 1
Dist:- Nascom,
92 Broad Street,
Chesham, Bucks HP5 3ED.
02405-75151.
+ regional network.

CPU Z80
RAM 1K/227K
I/O SER PARA
CASS YES
BASIC OPT
Other
DISC
m/c 1K
£125

Extras:- Motherboard, RAM, printer.
Applications:- Full keyboard machine code system, expandable.

NASCOM 2
Dist:- As NASCOM 1

CPU Z80A
RAM 1K/227K
I/O SER PARA
CASS Kansas
BASIC 8K Microsoft
Other Pascal
DISC Opt
m/c 2K monitor + CP/M
£225

Extras:- Printer, RAM, case, discs.
Applications:- Low cost kit system, developed from Nascom 1.
Reviewed:- February '80

National Panasonic

PANASONIC JD800/840
Dist:- Panasonic Business Equip.,
9 Connaught Street,
London W2 2AY.
01-262 3121.
+ regional distributors.

CPU 8085A
RAM 56K
I/O SER
CASS N/A
BASIC YES
Other COBOL
DISC 2x8"
m/c CP/M
£4,275 (hardware), £8,000 upwards for packages
Extras:- Printers and software from regional distributors.
Applications:- Complete small business system with software support.

Netronics

ELF II
Dist:- Newtronics,
255 Archway Road,
London N6.
01-348 3325.

CPU 1802
RAM ¼/4K
I/O PARA
CASS OPT
BASIC OPT
Other
DISC
m/c 1K
£60

Extras:- Motherboard, RAM, I/O.
Applications:- Low cost kit for Hex programming.
Reviewed:- October '79

EXPLORER 85
Dist:- As ELF II

CPU 8085
RAM 4K
I/O PARA
CASS YES
BASIC 8K OPT
Other
DISC
m/c 2K
£285 upwards

Extras:- Normal S100 goodies, case.
Applications:- Kit, S100 based.
Reviewed:- June '80

Newbear

77-68
Dist:- Newbear,
40 Bartholomew Street,
Newbury, Berks.
0635-30505.
+ 2 regional shops.

CPU 6800
RAM 4K/56K
I/O Various
CASS YES
BASIC OPT
Other NO
DISC
m/c 1K
£40 upwards

Extras:- 6809 upgrade, I/O, discs.
Applications:- Rack based kit system.

North Star

NORTHSTAR HORIZON
Dist:- Comart Ltd.,
P.O. Box 2, St Neots,
Huntingdon, Cambs PE19 4NY.
0480-215005.
+ many regional dealers.

CPU Z80
RAM 32K/56K
I/O SER PARA
CASS N/A
BASIC YES
Other Various
DISC 2x5¼"
m/c CP/M
£1,600 - 2,000

Extras:- Discs, VDU, printer.
Applications:- S100 based system with good software support.

Ohio Scientific Instruments

SUPERBOARD II, (C1)
Dist:- Mutek,
Quarry Hill, Box, Wiltshire.
0225-743289.
+ many regional

CPU 6502
RAM 4K/8K
I/O PARA BUS
CASS YES
BASIC 8K Microsoft
Other NO
DISC NO
m/c 2K
£150 cased + psu + mod = C1 @ £220

Extras:- Discs, Memory, case.
Applications:- Naked single board with BASIC, modified display for UK market.
Reviewed:- July '79

CHALLENGER, C2
Dist:- As SUPERBOARD II

CPU 6502
RAM 4K/32K
I/O SER PARA
CASS Kansas
BASIC 8K
Other NO
DISC OPT
m/c 2K
£349

Extras:- Disc, printer, memory.
Applications:- 4 slot backplane machine, upgraded system.

CHALLENGER, C4
Dist:- As SUPERBOARD II

CPU 6502
RAM 8K/32K
I/O SER PARA
CASS YES
BASIC 8K
Other NO
DISC OPT
m/c 4K
£395

Extras:- Disc, printers, etc.
Applications:- Upgraded C2 with colour graphics.

CHALLENGER, C8P
Dist:- As SUPERBOARD II

CPU 6502
RAM 8K/32K
I/O SER PARA
CASS YES
BASIC 8K
Other NO
DISC OPT
m/c 4K
£475

Extras:- Disc, printers, etc.
Applications:- Upgraded C2 with colour graphics.

CHALLENGER, C3
Dist:- As SUPERBOARD II

CPU 6502, 6800 + Z80
RAM 48K/58K
I/O Various
CASS N/A
BASIC YES
Other Various
DISC 2x8"
m/c DOS
£2,450

Extras:- VDU, printer, software
Applications:- Triple CPU system for business use etc.

Periflex

PERIFLEX 630/48
Dist:- Sintrom,
Arkwright Road, Reading,
Berks. RG2 0LS.
0734-85464.

CPU Z80
RAM 48K
I/O Various
CASS N/A
BASIC various
Other Various
DISC 2x5¼"
m/c CP/M2
£2,500

Extras:- VDU, printers, S100 board set.
Applications:- S100 based systems.

PERIFLEX 1024/64
Dist:- As 630/48

CPU Z80
RAM 64K
I/O Various
CASS N/A
BASIC Various
Other Various
DISC 2x8"
m/c CP/M 2
£3,300

Extras:- VDU, printers.
Applications:- S100 based boxed computer.

Powerhouse

POWERHOUSE 2
Dist:- Powerhouse,
5 Alexandra Road,
Hemel Hempstead, Herts HP2 5BS.
0442-48422.

CPU Z80A
RAM 32K/64K
I/O SER PARA.P
CASS YES
BASIC Yes
Other No
DISC OPT
m/c 2K
£1,250

Extras:- Graphics, I/O, printer.
Applications:- 5'' VDU based system used in scientific and industrial control.

POWERHOUSE 3
Dist:- As POWERHOUSE 2

CPU Z80A
RAM 32K/64K
I/O SER PARA.P
CASS N/A
BASIC Yes
Other Various
DISC 2x5¼"
m/c CP/M
£2,250-**£**2,750

Extras:- Graphics, I/O, printer.
Applications:- 9'' VDU based system with potential DP and small business applications.

Powertran

PSI COMP 80
Dist:- Powertran Electronics,
Portway Industrial Estate,
Andover, Hants SP10 3MN.
0264-64456.

CPU Z80
RAM 3K/32K
I/O Various
CASS Kansas
BASIC 2K
Other NO
DISC
m/c 1K
£255

Applications:- Mathematical/number crunching with special on-board chip.

Rair

BLACK BOX
Dist:- Rair Ltd.,
30-32 Neal Street,
London WC2H 9PS.
01-836 4663.

CPU 8085A
RAM 32K/64K
I/O SER
CASS N/A
BASIC Various
Other Various
DISC 2x5¼"
m/c CP/M
£2,500 upwards

Extras:- VDU's, printer, hard and floppy discs.
Applications:- Disc based professional system capable of handling up to 16 terminals.

Research Machines

RML 380Z
Dist:- Research Machines,
P.O. Box 75, Mill St.,
Oxford.
0865-49791.

CPU Z80A
RAM 16K/56K
I/O Various
CASS CUTS 300/1200 baud
BASIC YES
Other Various
DISC OPT
m/c 3K
£897 upwards

Extras:- Graphics, printer, etc.
Applications:- Educational system of high quality.

Rockwell

AIM 65
Dist:- Pelco Electronics,
Enterprise House, 83-85 Wester Road,
Hove, Sussex BN3 1UB.
0273-722155.
+ several regional outlets.

CPU 6502
RAM 1K/4K
I/O SER PARA
CASS 2
BASIC 8K Opt
Other
DISC
m/c 8K
£265 upwards

Extras:- Discs, RAM, VDU, cases, etc.
Applications:- Versatile single board with single line display and thermal printer.
Reviewed:- Dec '79

SGS Ates

NANOCOMPUTER
Dist:- SGS Ates,
Planar House, Walton Street,
Aylesbury, Bucks.
0296-5977.

CPU Z80
RAM 4K/16K
I/O SER 2PARA
CASS YES
BASIC 8K opt
Other
DISC
m/c 2K
£240 upwards

Extras:- Experimenter systems, full system capability.
Applications:- Educational single board that can grow to full system.
Reviewed:- Aug '79

Sinclair Research

ZX80
Dist:- Science of Cambridge,
6 Kings Parade,
Cambridge, Cambs CB2 1SN.
0223-311488.

CPU Z80A
RAM 1K/16K
I/O PARA BUS
CASS YES
BASIC YES
Other NO
DISC NO
m/c
£80 kit, £100 built

Extras:- Kit or ready built, PSU, 16K RAM 8K BASIC
Applications:- Touch keyboard, low-cost beginners/educational system
Reviewed:- June '80

ZX81
Dist:- As ZX80

CPU Z80A
RAM 1K/16K
I/O BUS
CASS YES
BASIC 8K
Other NO
DISC NO
m/c NO
£69.95

Extras:- 16K RAM, Printer (June)
Applications:- Upgraded version of ZX80, also available as a kit for £49.95.

Sharp Electronics

MZ-80K
Dist:- Sharp UK Ltd.,
Thorn Road, Newton Heath,
Manchester M10 9BE.
061-205 2333.
+ growing regional network including Microdigital and Newbear.

CPU Z80
RAM 6K/34K
I/O PARA
CASS YES
BASIC 14K
Other
DISC Opt
m/c 4K
£480 to £599

Extras:- Discs, printer, I/O adaptor
Applications:- Japanese desktop system expanding to business market.

PC 1211
Dist:- As MZ-80K

CPU 4 bit Custom
RAM
I/O NO
CASS YES
BASIC YES
Other NO
DISC NO
m/c NO
£120 approx inc cassette adaptor

Extras:- Printer adaptor soon.
Applications:- 1424 step BASIC programmable handheld computer using LCD display.

PC-3201
Dist:- As MZ-80K

CPU Z80A
RAM 64K
I/O PARA.P
CASS YES
BASIC 32K Extended
Other —
DISC OPT
m/c —
£2,995 for complete system

Extras:- Twin 5¼" discs (568K) expandable to 8 drives, printer.
Applications:- Small business system with a commercially oriented version of BASIC.

Smoke Signal

SMOKE SIGNAL CHIEFTAIN
Dist:- Strumech,
Portland House, Coppice Side,
Brownhills, Walsall, West Midlands.
05433-4321.
+ Windrush.

CPU 6800
RAM 32K/56K
I/O SER SS50 BUS
CASS N/A
BASIC YES
Other Various
DISC OPT
m/c 1K + DOS
£3,000

Extras:- Floppies, printers, VDUs.
Applications:- Mainly supplied to education and research although suitable for business.

Sord

M100 ACE Mk III
Dist:- Exleigh Business Machines Ltd.,
11 Market Place, Penzance,
Cornwall TR18 2JB.
0736-66577.
+ Midas Computer Services, 2 High Street,
Steyning, W Sussex BN4 3GG
0903-813913

CPU Z80
RAM 48K
I/O Various
CASS N/A
BASIC YES
Other FORTRAN
DISC 2x5¼"
m/c
£2,259

Extras:- More discs, Colour graphics
Applications:- Personal or small business machine from Japan based on the S100 bus.

M203 Mk III
Dist:- As M100 ACE

CPU Z80A
RAM 64K
I/O Various
CASS N/A
BASIC YES
Other Various
DISC 2x5¼"
m/c CAP.BOS
£2,979

Extras:- 2 x 8" floppies, 2 more 5¼" floppies
Applications:- Process control, wordprocessing, business system with CAP/CPP software.

M223 Mk III
Dist:- As M100 ACE

CPU Z80A
RAM 64K
I/O Various
CASS N/A
BASIC YES
Other Various
DISC 2x5¼"
m/c CAP.BOS
£3,489

Extras:- 4 x 8" floppies, more 5¼" floppies, up to 4 x 8 Mb Hard disc.
Applications:- As the M203 but with a full S100 bus to allow system expansion.

Southwest Technical Products

SWTP 6800/6809
Dist:- Southwest Technical,
38 Dover Street,
London W1X 3RB.
01-491 7507.

CPU 6800 or 6809
RAM 8K/56K
I/O Various
CASS YES
BASIC Various
Other Various
DISC OPT
m/c 2K

Extras:- Discs, printer, VDU.
Applications:- SS50 based system with good software support.

Tandy Corporation

TRS-80 Level 1 & 2
Dist:- Tandy Corporation,
Bilston Road, Wednesbury,
West Midlands WS10 7JN.
021-556 6101.
+ regional shops

CPU Z80
RAM 4K/48K
I/O OPT
CASS YES
BASIC 2 versions
Other FORTRAN
DISC OPT
m/c 4K
£380 - £560

Extras:- Discs, printers, I/O.
Applications:- Top selling system with "separates" approach.
Reviewed:- November '79

TRS-80 Model II
Dist:- As TRS-80

CPU Z80
RAM 32K/64K
I/O SER PARA
CASS N/A
BASIC YES
Other
DISC 8"
m/c
£2,000 upwards

Extras:- Printer, disc.
Applications:- Upgraded business version of Model I.

Tangerine Computers

MICROTAN 65
Dist:- Tangerine Computers,
Forehill, Ely, Cambs.
0353-3633.
+ regional dealers

CPU 6502
RAM 1K/48K
I/O BUS
CASS OPT
BASIC OPT 10K
Other NO
DISC NO
m/c 1K
£69 upwards

Extras:- Tanex board for I/O, BASIC, etc + racking,cases.
Applications:- Machine code system, kit or built that expands to a full computer.
Reviewed:- June '80

MICRON
Dist:- As MICROTAN 65

CPU 6502
RAM 8K/227K
I/O 1 SER, 4 PARA
CASS CUTS 300 or 1200 special
BASIC 10K Microsoft
Other NO
DISC NO
m/c 3K
£395 inc

Extras:- RAM, Discs, I/O rack system
Applications:- Cased built system with excellent expansion possibilities.
Reviewed:- October '80

Technalogics

TECS
Dist:- Technalogics,
8 Egerton St., Liverpool,
Merseyside L8 7LY.
051-724 2695.
+ 1 Regional Distributor.

CPU 6800
RAM 16K/56K
I/O SER PARA
CASS 2
BASIC 3K
Other YES
DISC OPT
m/c 4K

Extras:- Discs, RAM, Prestel Software
Applications:- Prestel editing terminal for IPs, could be used as a Teletext/Prestel based personal system.
Reviewed:- May '79

Texas Electronic Instruments

TEI 208-212
Dist:- Abacus,
62 New Cavendish Street,
London W1M 7LD.
01-580 8841.

CPU Choice
RAM 32K/60K
I/O PARA SER
CASS N/A
BASIC YES
Other Various
DISC 2x5¼"
m/c CP/M
£3,535-4,497

Extras:- 8" discs (212) printers, hard disc soon
Applications:- Integral VDU models forming the basis of a business system.

Texas Instruments

TI 99/4
Dist:- Texas Instruments,
European Consumer Division,
Manton Lane, Bedford MK41 7PA.
0234-67466.

CPU 9900
RAM 16K
I/O PARA BUS
CASS 2
BASIC 14K
Other NO
DISC OPT
m/c 12K
£995

Extras:- Discs, speech synthesiser
Applications:- Colour graphics machine with "plug-in" software. Needs US TV, soon to change.

Transam

TRITON
Dist:- Transam,
59-61 Theobalds Road,
London WC1.
01-405 5240.

CPU 8080
RAM 1K/3K
I/O PARA BUS
CASS Kansas
BASIC Various
Other Pascal
DISC OPT
m/c Various monitors
£294 to £1,000

Extras:- Cases, Discs, Motherboard, Assembler package
Applications:- Versions available for most requirements, from educational to research.
Reviewed:- May '80

TUSCAN
Dist:- As TRITON

CPU Z80
RAM 1K/8K
I/O SER PARA
CASS YES
BASIC OPT
Other Pascal
DISC OPT
m/c 2K
£195 upwards

Extras:- Casing, VDU option, discs, Firmware, S100 boards
Applications:- S100 based kit, development style system. Also ready built.

Transdata

Cx400
Dist:- Transdata Ltd.,
Battlebridge House, 87-95 Tooley Street,
London SE1.
01-403 5115

CPU 8080
RAM 16K/48K
I/O 4 SER, BUS
CASS –
BASIC YES
Other MICRO COBOL
DISC 8"
m/c Monitor
£1,450-2,750

Extras:- Multiple 8" drives.
Applications:- Multiprocessor architecture system for "front-ending".

Cx500
Dist:- As Cx400

CPU Z80A
RAM 64K
I/O 4 SER, BUS
CASS –
BASIC Microsoft
Other Various
DISC 2 x 8" DS
m/c CP/M MP/M
From **£**3,500

Extras:- 20Mb Winchester ¼" magtape cartridge.
Applications:- Multiprocessor structured system for OEM market.

Vector Graphic

SYSTEM B
Dist:- Almarc Data Systems,
906 Woodborough Road,
Nottingham NG3 5QS
0602-625035.
+ regional dealers

CPU Z80
RAM 56K
I/O SER PARA
CASS N/A
BASIC Various
Other Various
DISC 2x5¼"
m/c CP/M 2
£3,200 upwards

Extras:- Printer, software, S100 boards
Applications:- Serious computing package complete with VDU and software.

VECTOR GRAPHIC 2800
Dist:- As SYSTEM B

CPU Z80
RAM 56K
I/O SER PARA
CASS N/A
BASIC Various
Other Various
DISC 2x8"
m/c CP/M 2
£4,195 upwards

Extras:- Printers, S100 boards, software
Applications:- Data processing and scientific/industrial computing. Terminal based system.

VECTOR GRAPHIC 3030
Dist:- As SYSTEM B

CPU Z80
RAM 56K
I/O SER PARA
CASS N/A
BASIC Various
Other Various
DISC 2x5¼" + 32Mb Hd
m/c CP/M 2
£TBA

Extras:- Printers, S100 boards, software.
Applications:- Hard disc based terminal system for DP.

VIP
Dist:- AS SYSTEM B

CPU Z80A
RAM 56K
I/O 1 SER, 3 PARA
CASS –
BASIC –
Other –
DISC 5¼"
m/c CP/M
£2,125

Extras:- Vector Graphic range
Applications:- Complete system with single disc and VDU. Six slot S100 bus.

Video Genie

VIDEO GENIE
Dist:- Lowe Electronics,
Bentley Bridge, Chesterfield Road,
Matlock, Derbyshire DE4 LEF.
0629-2817.
+ dealer network.

CPU Z80
RAM 16K/48K
I/O PARA BUS
CASS YES
BASIC 10K
Other
DISC OPT
m/c 2K
£425 inc VAT

Extras:- Printer, discs via Tandy style expansion unit.
Applications:- HONG KONG copy of TRS-80 and which also runs Level 2 software. Now available with colour graphics.
Reviewed:- May '81

Xerox

DIABLO 3000
Dist:- Business Computers,
The Pagoda, Theobald Street,
Borehamwood, Herts WD6 4RT.
01-207 3344.

CPU 8085
RAM 32K/64K
I/O SER
CASS N/A
BASIC YES
Other DACL
DISC 2x8"
m/c DOS
£8,950-**£**15,000

Extras:- Business software, Printer, Communications adapter
Applications:- Complete business system that can be multi-tasked. Price includes software.

DIABLO RANGER 3200
As DIABLO 3000

CPU 8080
RAM 32K/64K
I/O SER
CASS N/A
BASIC YES
Other DACL
DISC 2x8"
m/c DOS
£10,865-**£**50,000

Extras:- Up to 4 discs, Up to 2 hard discs, Printers, Communications adapter.
Applications:- Complete system that can run up to eight jobs simultaneously, price includes software.

Zenith Data Systems

ZENITH Z89
Dist:- Zenith Data Systems,
Heath Electronics, Bristol Road,
Gloucester GL2 6EE.
0452-29451.
+ London shop 01-636 7349.

CPU Z80
RAM 16K/64K
I/O SER
CASS OPT (H88)
BASIC YES
Other Various
DISC 5¼"
m/c CP/M, HDOS
£1,570 upwards

Extras:- Dual 8" discs, printer
Applications:- Integrated system of very high quality, also available as a kit.
Reviewed:- June '80

ZENITH Z11
Dist:- As Z89

CPU LSI 11
RAM 16K/32K
I/O Various
CASS N/A
BASIC YES
Other Various
DISC OPT2x8"
m/c N/A
£1,250

Extras:- Discs, printer, VDU
Applications:- LSI 11 compatible 16 bit system.

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PURCHASES LEDGER	(500+ Accounts, 100 Departments).	£295
GENERAL (OR NOMINAL) LEDGER	(1000 Accounts, 100 Analyses, multi-purpose package). Job costing etc.	£295
UTILITIES DISK 1	(Diskette patch, slot to slot copy, zap etc).	£20
APPLEWRITER	(Word Processing, see below for U/L case).	£42
VISICALC	(Financial Modelling, Costing, Analysis).	£125
CAI	(Converts Apple pictures for ITT display).	£10

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MICROLINE M80 PRINTER £345

This neat, reliable machine prints at 10 characters per inch, 80 characters on an 8 inch line, or 40 expanded characters, or 132 very readable characters, upper and lower case and graphics, 9 x 7 dot matrix, 6 or 8 lines per inch. Parallel interface is standard, serial optional. Both friction and sprocket feed are standard, tractor optional. We can also supply the parallel interface card for Apple System computers for £80 and a driver to enable both text and graphics to be used. Optional custom colour matching for Apple or ITT. Optional character sets. *Trade supplied at very generous discounts for modest quantities.*

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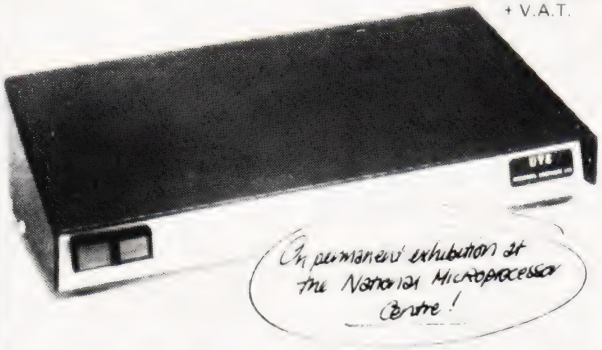

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Union St, Trowbridge, Wilts.

march communications

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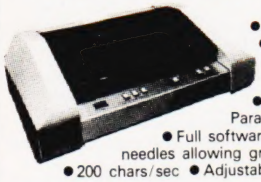

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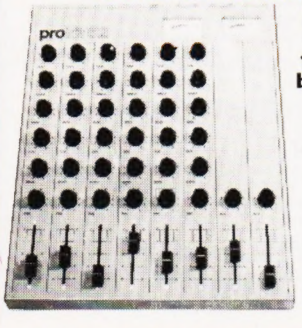

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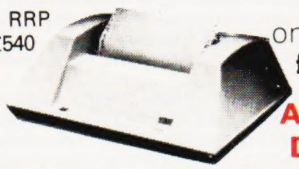

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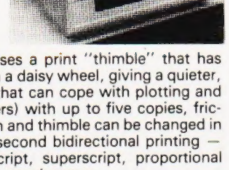

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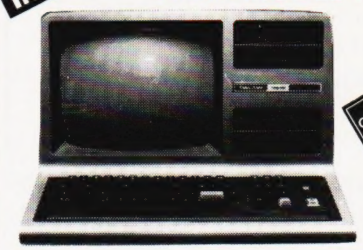

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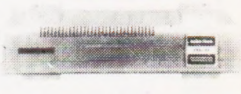

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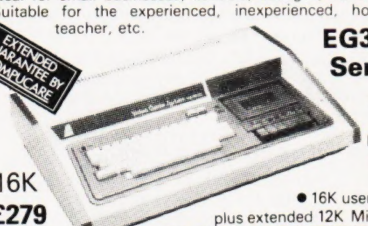

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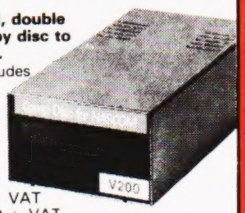

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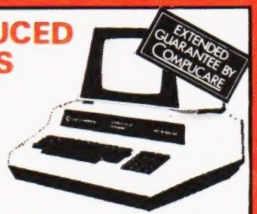

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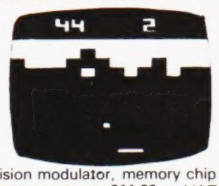

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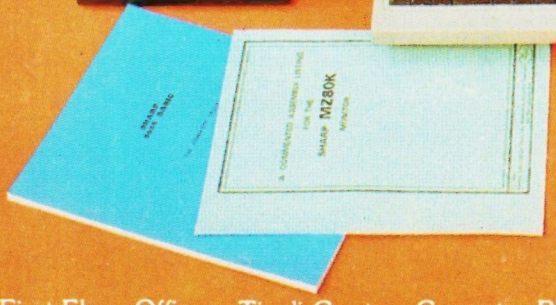

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